Report of The Review Committee on Foreign Technical Assistance Received by the Indian Institutes of Technology and Other Academic Institutions

Ministry of Education and Culture
Government of India
New Delhi
1980

"Letter of Transmittal"

CENTRAL LEATHER RESEARCH INSTITUTE
ADYAR, MADRAS-600020

PROF. Y. NAYUDAMMA
Ph.D., F.N.A.
Distinguished Scientist

Telephone No. : 412505/412616
Telex : MS 514 Code : LESERCH
Dated 8th January '80

My dear Sabanayagam,

I have great pleasure in transmitting to you the Report of the Railway Committee on Foreign Technical Assistance received by the IITs and other academic institutions.

The Committee had a close look at the assistance given to IITs and referred to a number of reports and documents. The Committee considers it important to distinguish between Technical Aid, Technical Assistance and Technical Cooperation. The foreign association has had a significant impact on the IITs, who may do well to interact with their counterparts in advanced countries on a continuing basis to reduce the temporal phase-lag in developing new emerging areas in our country.

The Committee also feels that it is unrealistic and unproductive to base development strategies on the availability of massive foreign 'aid' (financial, scientific and technological). Foreign technical assistance programmes should be used only on a selective and coordinated basis, both in regard to the areas of national importance and priorities and the countries, matching the country's competence with the specific subject. This assistance is to supplement and complement our competence. It is most important to promote and foster trans-disciplinary approach and trans-organisational activity maximising utilisation of available resources, facilities and talents within the country before we seek foreign assistance. Keeping such issues in mind, the Committee has made some specific suggestions for processing proposals for foreign technical assistance. The limitations of the report and the need for further study in some areas have also been pointed out.

It is hoped that the various recommendations made in the report would be of interest and use to the Government and other agencies. The implementation of the recommendations made in the report may have positive consequences and benefits to the country at large.

It was a privilege for the Committee to work together on this important assignment. To me, it has been a valuable learning experience. I would like to take this opportunity to express my gratitude to all members of the Committee and more particularly to the dynamic and devoted Member Secretary Dr. Gopalan.

For any further information you may require on this report, please do not hesitate to demand my service.

With regards.

Yours sincerely,

(Prof. Y. Nayudamma)

Shri P. Sabanayagam,
Education Secretary,
Ministry of Education and Culture,
New Delhi.

CONTENTS

ANNEXURES

INDIAN INSTITUTES OF TECHNOLOGY ETC.

Brief Summary of Findings and Recommendations

1 Foreign technical assistance has had a significant impact on the IITs and in turn on the technical education system in the country. It has helped the IITs to develop expertise of international standards and to build up competent R&D infrastructure in a wide variety of scientific and technological fields. (3.1, 3.2, 3.3, 3.4, 3.6 and 9.2)

2. The IITs should interact with their counterparts in advanced countries on a continuing basis to reduce the temporal phase-lag in developing emerging areas which are relevant to the national needs. These areas have been identified in the report. (3.3, 5.1, 7.0, 7.1, 7.2, 7.3, 8.1, 9.3, 9.4 and 9.5)

3. It is unrealistic and unproductive to base development strategies on the availability of massive foreign technical assistance/collaboration/aid programmes. These programmes should be used only on a selective basis for new and emerging areas, for inter-action in areas of excellence and for procuring sophisticated equipment not available indigenously. In all these cases, the proposals should be based on overall national priorities and commitments. (6.0, 7.1, 7.2, 7.3, 8.5.2, 8.5.11 and 9.7)

4. No foreign technical assistance programme should be such that it would perpetuate our dependence in the area concerned on foreign expertise and support. Foreign technical assistance/collaboration/aid programmes should not be aimed at replacing existing indigenous endeavours ; they should be directed to strengthening and upgrading them. (8.5.2, 8.5.3, 8.5.4, 8.5.5, 9.8 and 9.9)

5. Proposals for foreign technical assistance/collaboration/aid received from the IITs and other academic institutions should not be considered in isolation. They should be considered on the basis of over-all national perspectives and in relation to what is happening in other departments and agencies in the country. All proposals for foreign technical assistance should therefore be considered by a National Screening Committee as suggested in the report. Representatives of industry may also be involved in this exercise. (8.5.1, 8.5.2, 8.5.11 and 9.10)

6. It is necessary to review the foreign training programmes of various agencies including government departments. Even in emerging areas, it is possible to give major part of the training in India. Such preparatory training in India would greatly enhance the benefits from foreign training inputs. (3.2, 5.4, 8.5.2, 8.5.7 and 9.12)

7 Foreign experts/consultants should be obtained only for absolutely essential areas of gaps in technology and that too only for short periods. But at the same time there should be a free flow of experts between India and other countries on equal partnership basis. Only sophisticated equipment/instruments which are not available indigenously should be included for import under foreign technical assistance programmes. Efforts should always be to develop such equipment/instruments in India. (5.2, 5.3, 8.5.2, 8.5.8, 8.5.9 and 9.13).

8. Institutions of the same category like the IITs should consult each other and submit to the National Screening Committee coordinated and agreed proposals for foreign technical assistance/collaboration/aid. (8.5.2, 8.5.10, 8.5.11 and 9.14)

9. There is a remarkable increase in the number of sponsored research projects undertaken by the IITs. These projects are now done on a no-profit no-loss basis. It is suggested that the IITs may be allowed to generate funds from sponsored research programmes on the basis of norms of charges to be laid down by the appropriate authorities. The IITs should not undertake routine testing jobs in the name of consultancy. (3.4 and 9.15)

10. The IITs should not work in isolation. They should build up and increase formal linkages with other academic institutions, R&D organisations and national laboratories. (3.5, 8.2, 8.5.11 and 9.16)

11. The IITs are competent and willing to give assistance—sans financial support—to institutions of lower formations in a variety of ways. Concrete steps should be taken to promote the flow of such technical assistance from the IITs to engineering colleges etc. The expertise available in the IITs to offer consultancy services should be fully utilised by the Educational Consultancy Company proposed to be set up under the auspices of the Government of India. (3.2, 3.3, 3.4, 8.2 and 9.17)

12. It is necessary to create in the IITs an infrastructure for training in the instrumentation area with particular reference to repairs and maintenance of sophisticated equipment. Each IIT should ensure that it is capable of maintaining and repairing its own equipment and also those of others in the region. (5.1, 5.2, 8.4 and 9.6)

13. There is need to establish in the IITs Centres for Assessment and Transfer of Technology (8.3 and 9.18).

1.0 Preamble

1.1 *Appointment of the Committee*

Early in 1978, while considering certain proposals for foreign technical assistance submitted by some IITs, the Planning Commission suggested that the Ministry of Education should undertake a review of the foreign technical assistance so far received by the IITs, the capabilities developed in the IITs with such assistance, and the areas that need to be further developed and supported through foreign technical assistance programmes. Accordingly, the following Committee was constituted for the purpose in June 1978 :

1. **Dr. A. Ramachandran**
   Secretary
   Department of Science & Technology. *Chairman*
2. **Prof. C. S. Jha**
   ex-Director, IIT, Kharagpur
   [now Educational Adviser (Tech.)
   Ministry of Education].
3. **Shri J. A. Kalyanakrishnan**
   Financial Adviser
   Ministry of Education and Social Welfare.
4. **Shri K. R. Sivaramakrishnan**
   Director (Education)
   Planning Commission.
5. **Dr. K. Gopalan**
   Deputy Educational Adviser (T) *Member-Secretary*

In October 1978, Dr. Ramachandran left India on a foreign assignment and Prof. Y. Nayudamma, former Director-General of CSIR, was appointed Chairman of the Committee.

1.2 *Terms of reference*

The terms of reference of the Committee were :

1. to review and evaluate the foreign technical assistance/aid so far received by the IITs,
2. to assess the capabilities developed in the IITs with such assistance/aid, and
3. to identify areas that need to be further developed and supported through foreign technical assistance/aid vis-a-vis the emerging areas and national perspectives.

It was subsequently suggested that the Committee could perhaps also have a look at the foreign technical assistance/aid received by other academic institutions and also make recommendations on the procedure and principles to be followed for processing proposals for foreign technical assistance received from academic (engineering and technological) institutions. It was further desired that the Committee should examine how the IITs could offer technical assistance to academic institutions of lower formations such as engineering colleges.

1.3 *Methodology adopted*

In its first meeting held on 30-11-78, the Committee discussed the methodology to be adopted to carry out the tasks assigned to it. It was resolved to first collect all relevant information from the IITs and then discuss the various aspects with the Directors and senior faculty members. Accordingly, information was collected from the IITs in the proforma placed at Annexure I. The Member-Secretary of the Committee went round to all the 5 IITs to get clarifications on the various data furnished by the IITs and also to collect additional information. At its meeting held on 10-3-1979, the Committee considered the information collected from the IITs and resolved to hold further discussions with the representatives of the Planning Commission and also with the Directors of the IITs. These discussions were held on 6-4-79 and 11-6-79 respectively. In its meeting with the Directors, the Committee posed several questions and the Directors were requested to give an agreed joint document on these queries. On this basis, the Directors submitted a joint document in August 1979. The Committee also consulted a large number of reports and documents a list of which is placed at Annexure II.

This report is the outcome of all these endeavours.

1.4 *Limitations of the report*

As pointed out in para 1.2 above, the Committee was primarily set up to review and evaluate the foreign technical assistance/aid received by the IITs. The Committee has therefore not attempted an in-depth study in respect of non-IIT institutions, the foreign inputs into which have of course been comparatively small.

The Committee has also not tried to scrutinise whether and how the educational policies/systems of the donor countries have influenced the technical education system in India or which countries have proved to be more effective than the others. It would be worth-while to undertake such an exercise separately.

1.5 *Types of foreign inputs*

The types of foreign inputs may be classified into three distinct categories. One is 'foreign technical assistance' to fill technological gaps that still exist and also to develop emerging areas in which adequate expertise is not yet available in the country. This would involve import of foreign expertise and equipment and also training of Indian faculty abroad.

The second is 'foreign collaboration' on equal partnership basis in areas where we have already built up competence of very high levels. This sort of collaboration would be necessary for all time to come to keep ourselves abreast of scientific and technological developments all over the world.

The third is 'foreign capital aid' by way of budgetary support to institutions to replace old obsolete equipment etc. if adequate internal resources (including necessary foreign exchange components) are not available for this purpose.

2.0 Quantum of Aid Received by the IITs

2.1 *Foreign input*

Foreign collaboration/technical assistance has been an important aspect in the growth and development of the IITs. The details of such assistance so far received by them are placed at Annexure III.

The Summary position is :

Institute	Equipment (Rs. in lakhs)	Guest faculty from abroad		Indian faculty training abroad	
		No.	Man-months	No.	Man-months
1	2	3	4	5	6
IIT, Delhi (Estd. 1961)	623.01	214	1114	175	2038
IIT, Kanpur (Estd. 1960)	373.19	120	2226	49	500
IIT, Madras (Estd. 1959)	1046.00	75	2254	123	1300
IIT, Bombay (Estd. 1958)	231.00	136	2352	27	810
IIT, Kharagpur (Estd. 1950)	106.66	---	220	—	560
GRAND TOTAL	2379.86		8166		5208

2.2 *Indian capital input*

The corresponding Indian capital input (for non-recurring items such as land, buildings, equipment, library etc.) is :

Institute	Indian input (Rs. in lakhs)
IIT, Delhi (1961)	900.00
IIT, Kanpur (1960)	1345.54
IIT, Madras (1959)	1400.00
IIT, Bombay (1958)	907.00
IIT, Kharagpur (1950)	1257.53
TOTAL	5810.07

2.3 *Foreign assistance in the pipeline*

The particualrs of foreign technical assistance now in the pipeline are placed at Annexure IV. The summary position is as follows :

Institute	Rs. in lakhs
IIT, Delhi (1961)	55.00
IIT, Kanpur (1960)	—
IIT, Madras (1959)	—
IIT, Bombay (1958)	45.00
IIT, Kharagpur (1950)	295.00
TOTAL	395.00

3.0 Impact of Foreign Collaboration/Technical Assistance/Aid

3.1 *General*

Foreign collaboration/technical assistance has had a significant impact on the IITs and in turn on the technical education system in the country. The IITs are today among the best-equipped technological institutions in the world.

The advice and assistance of foreign (guest) faculty from various advanced countries have helped to successfully introduce several innovative practices such as new curricula, internal evaluation core curricula programmes, science based engineering education etc. These innovative ideas and programmes have to a large extent percolated to the technical education system in the country. The exposure and training of Indian faculty in different advanced countries abroad have helped to produce in the IITs a large number of highly qualified and competent faculty in all areas of science, engineering and technology.

All these have helped the IITs to educate and train scientists, engineers and technologists of very high calibre comparable to the very best produced anywhere in the world. The IITs have made and are still making remarkable contributions in the area of faculty development, curriculum development etc. through the various QIP Programmes.

3.2 *Training of engineers, technologists and scientists*

As on 1st January, 1979, the IITs have produced about 35000 engineers, scientists and technologists of high calibre and competence. The details of such personnel produced by the various IITs (till 1st January, 1979) are given below :

Degree	Delhi (1961)	Kanpur (1960)	Madras (1959)	Bombay (1958)	Kharagpur (1950)	Total
1	2	3	4	5	6	7
1. B. Tech.	2679	2632	4547	4107	6639	20604
2. M. Tech.	1215	1437	1694	2050	3106	9502
3. Ph. D. (Engg.)	174	217	242	222	397	1252
4. Ph. D. (Sc.)	244	320	187	162	343	1256
5. Ph. D. (Humanities)	—	—	—	—	7	7
6. B.Sc.	—	—	—	—	562	562
7. M.Sc.	310	387	482	482	714	2375
8. D.I.I.T. (Engg.)	210	—	186	355	373	1124
9. D.I.I.T. (Sc.)	—	—	—	—	298	298
10. D.I.I.T. (Humanities)	—	—	—	—	43	43
11. M.S.	27	—	138	—	—	165
12. D.Sc. (Engg.)	—	—	—	—	2	2
13. D. Sc. (Sc.)	—	—	—	—	7	7
TOTAL	4859	4993	4696	7378	12491	34417

3.3 *Expertise and competence developed*

Foreign collaboration/technical assistance has helped the IITs to develop expertise and competence at national and international levels in a wide variety of scientific and technical fields. A large number of highly specialised laboratories with a lot of modern sophisticated equipment have been set up in each IIT. The lists of areas in which each IIT has developed expertise and competence of highly comparable standards along with the names of experts in each area are placed at Annexures V to IX. These areas of expertise have been arrived at on the basis of the following criteria :—

(i) Number of publications in journals of repute.
(ii) Number of Ph.D./M. Tech. projects undertaken.
(iii) Number of patents and awards obtained.
(iv) Number of sponsored projects and consultancy jobs undertaken.
(v) Strength of the group in terms of faculty positions.
(vi) Research facilities available.

3.4 *Consultancy and R&D activities*

Thanks to the availability of high level expertise in many areas and the presence of several specialised laboratories and workshops, each IIT is today also a centre of consultancy and R&D activities. The number and value of consultancy and sponsored research projects are steadly picking up. The number of consultancy and sponsored research projects undertaken by the various IITs and the number of papers published during 1977-78 are given below :—

	Consultancy projects	Sponsored research projects	Papers Published
1	2	3	4
IIT, Delhi	92	100	508
IIT, Kanpur	103	102	1000
IIT, Madras	197	108	717
IIT, Bombay	272	45	453
IIT, Kharagpur	80	100	466
TOTAL	744	455	3144

While consultancy projects do generate funds in a limited way, sponsored research projects are undertaken on a no-loss no-profit basis. It is for consideration whether the IITs should not be allowed to generate funds from sponsored research projects on the basis of norms of charges to be laid down by appropriate authorities.

There are complaints that some of the IITs are undertaking too many routine testing jobs in the name of consultancy and this is seriously interfering with the academic and research activities. The IITs should not undertake such routine testing work.

An integrated statement in respect of the IITs regarding the quantification of different components of training (including research training) sponsored research, consultancy etc. as a percentage of their total activity is given below :—

	Training	Research Training	Sponsored Research	Consultancy
1	2	3	4	5
IIT, Delhi	40%	31%	25%	4%
IIT, Kanpur	36%	38%	23%	3%
IIT, Madras	40.5%	36.6%	17.3%	5.6%
IIT, Bombay	41%	38%	16%	5%
IIT, Kharagpur	44%	36%	17.8%	2.2%

The qualification of activity at the various IITs has been based on common norms. There is more or less uniformity amongst IITs in terms of break-up. It is significant to note that 60 per cent of the budget goes to research, sponsored research and consultancy etc., and the remaining 40 per cent goes to training which also includes training at the Master's level. The break-up is given in terms of expenditure but this does not necessarily reflect the amount of time spent in R&D activity. Indeed, experience shows that a significant portion of the time of a faculty member is devoted to post-graduate training, research, sponsored R&D and consultancy.

3.5 *Linkages with other organisations and agencies*

The IITs have established formal linkages with a few agencies. Some typical examples are :—

(i) Industry oriented programme for HAL at the IIT Madras comprising training of graduate apprentices and process planners, and running of post-graduate course on Aircraft Production.

(ii) Manpower training and research in futuristic areas for the Ministry of Defence at all the IITs.

(iii) Establishment of a Research Centre by the textile industry at the IIT Delhi to solve fundamental problems relating to textile industry and undertaking of R&D work.

(v) Establishments of collaborating programmes with Technical Teachers' Training power systems studies.

(v) Establishment of collaborating programmes with Technical Teachers' Training Institute, Bhopal for providing necessary technical guidance at the IIT Kharagpur.

(vi) Establishment of Regional Sophisticated Instrumentation Centres by the Department of Science and Technology at the IITs at Bombay and Madras.

(vii) Laser Development Activity for Central Electronics Ltd., at the IIT Kanpur.

In addition to the above, several informal linkages exist between the IITs and several public and private sector undertakings.

It is necessary that the IITs should increase their formal linkages with relevant organisations/agencies for mutual benefit and interaction.

3.6 *Some negative aspects*

One of the criticisms against the IITs is that the training imparted in them is elitist in character and is based on alien culture oriented towards the needs of the developed countries. The trend of education fostered in the IITs is alleged to be irrelevant to the immediate development needs of India.

According to certain studies, about 25 per cent of the IIT graduates leave the country every year and they are all First Divisioners. Apart from the physical and social costs of brain drain that are usually computed, an important dimension of the loss is the "reverse transfer of technology" through the migration of such high quality manpower to the developed countries. The loss of the potential for innovative technology embodied in every IIT graduate who migrates is a defeat of the very purpose of the high quality technological education.

The IITs have grown sufficiently to make the transition from secondary response to primary initiative, from unit problem solution to system development and management of experts as a team rather than as individuals. But this transition is yet to take place.

4.0 Foreign Technical Assistance Received by Academic Institutions Other than IITs

The Committee tried to collect information on foreign technical assistance so far received by some of the important academic institutions other than the IITs. The position as furnished by the various institutions is at Annexure X. The 17 non-IIT institutions have so far received about Rs. 5.5 crores worth of equipment, 1781 man-months of faculty training abroad and 2836 man-months of foreign experts. These institutions have said that the assistance they received has been of great use. They have claimed expertise in various areas and have asked for massive foreign technical assistance for various purposes.

The Roorkee University has said that it has not received any foreign technical assistance in any form. While the Indian Institute of Management, Bangalore, did not formally respond, its Director informed over telephone that the Institute had not received any foreign technical assistance.

5.0 Problems of Foreign Collaboration/Technical Assistance/Aid

5.1 *Problems of spares and obsolescence*

The IITs at Kanpur and Madras indicated that they did not have any problems regarding spares for imported equipment. The IIT Kanpur had ordered adequate spares alongwith the equipment and also obtained spares through the 5000-rupee scheme of the Government of India. In the case of the IIT Madras, the continuing nature of the agreement with Germany took care of the problem.

The IITs at Bombay, Kharagpur and Delhi have reported problems regarding spares. The worst affected Institutes are those at Bombay and Kharagpur whose collaboration programmes with foreign countries stopped long ago. Since 1968, the IIT Bombay has not been able to get any spares for equipment from the USSR. Similar is the story of the IIT Kharagpur. The IIT Delhi has complained that many items of imported equipment are lying idle because of lack of spares.

The list of equipment lying idle in the various IITs because of lack of spares is placed at Annexure XI. (The IIT Kanpur did not submit this list). A team of competent technicians/experts should examine these items of equipment and make suggestions to put them to use. If it is not possible to put them to use without getting spares from abroad, then immediate steps should be taken to get the spares imported.

All the IITs have reported that they have lots of equipment which are in good condition, but obsolete from the point of view of their levels of training and research. A list of such equipment is placed at Annexure XII. (The IIT Kanpur did not submit this list). The IITs feel that these equipment could be transferred to engineering colleges and polytechnics, where they could still be put to effective use. Some methodology should be worked out to effect this transfer of obsolete equipment from IITs to engineering colleges, polytechnics, etc. Incidentally such transfer of obsolete equipment would to some extent solve the problem of space requirements of the IITs.

The lists at Annexures XI and XII do not appear to be exhaustive. The Institutes should have a second look at their laboratories and make these lists exhaustive for further necessary action as suggested above.

5.2 *Restrictions on import of equipment*

Under the Indo-UK Collaboration agreement in respect of the IIT Delhi only equipment of UK origin could be ordered. In respect of other agreements, the Institute did not have any such restrictions. In the case of Indo-American programme for the IIT Kanpur, the stipulation was that when available the equipment should be purchased from the American market.

The IITs at Kharagpur and Madras did not seem to have had these problems. All items of equipment were supplied as specified by them.

The IIT Bombay did not have any choice or say in the selection of equipment got from the USSR. This has created lots of difficulties. Many items of equipment were not at all of the laboratory type and hence, were unfit for instructional and research purposes.

5.3 *Foreign (guest) faculty*

By and large, the foreign faculty who came to the IITs under the various technical assistance programmes were of good calibre. Some of them were truly outstanding. They have made effective contributions to the progress and development of the various Institutes.

The IITs at Delhi, Kanpur and Madras had a say in the selection of foreign faculty. They could therefore, choose the right people based on their specific requirements. On the other hand the IITs at Kharagpur and Bombay did not have any say in the selection of foreign faculty (they were neither asked nor consulted) and to that extent, they had some difficulties. Under the first Indo-UK agreement in respect of the IIT Delhi, several experts came on long-term basis (3—5 years). They were not necessarily the top men in their respective fields. The general experience is that top experts could be got under technical assistance programmes only on short-term basis.

5.4 *Training of Indian faculty abroad*

All the IITs have reported that they were satisfied with the training their faculty/staff got abroad under the various technical assistance programmes. In retrospect, the IIT Kanpur has felt that sending a large number of technical staff would have gone a long way in providing the necessary capabilities for manning the large number of sophisticated activities. In the case of the IIT Bombay, only junior faculty could go to the USSR and that too for Ph.D. work. The Institute feels that senior faculty members must be deputed abroad on short-term basis to exchange ideas and to familiarise themselves with the latest developments. The IIT Delhi has opined that the faculty deputed abroad should be given a chance to involve themselves in industrial consultancy.

6.0 Model for future Technical Assistance Programmes

All the IITs have spoken strongly in favour of technical assistance programmes on a continuing basis, as is the case now in respect of IITs at Madras and Delhi. This is absolutely necessary to keep and maintain the high levels of research and development activities especially in emerging areas up to date and at international levels. Technology is fast changing and it is imperative that the IITs should keep themselves abreast of modern developments. In emerging areas the IITs should interact with foreign institutions on a continuing basis to reduce the temporal phase lag in developing these areas in our country. In this respect, the IITs at Kanpur, Kharagpur and Bombay have been at a disadvantage in that their technical assistance programmes concluded long ago.

As far as the model for future technical assistance programme is concerned the IITs at Kanpur and Bombay have favoured the consortium concept. The IIT at Kanpur got technical assistance from the USA in the form of a consortium of nine leading educational institutions and one administrative organisation. This model provided a large pool of highly qualified faculty and staff from which persons with the required specific qualifications could easily be identified. It is based on this experience that the Institute has suggested the consortium concept as a model for future collaboration. All the IITs are agreed that future technical assistance programmes should be on equal partnership basis with provision for doing joint research projects in areas of mutual interest holding joint seminars/symposia in India and abroad etc.

Though it is prepared to have collaboration with any country based on the special expertise developed by a particular country, the IIT Kanpur would prefer to have all future technical assistance programmes with the USA. Similarly, the IIT Madras would prefer to continue its collaboration with West Germany but would also like to have collaboration with France, UK and Japan in specific areas. The IITs at Delhi, Kharagpur and Bombay would like to have collaboration with various countries.

It is difficult to prescribe any fixed model for foreign technical assistance. Each case must be considered on its merits. But, whatever the model all such programmes especially in respect of the IITs should as far as possible be on equal partnership basis.

One could possibly consider that each IIT might deal with a consortium of one parent country and yet keep its doors open for collaboration with other countries in specific areas of their competence.

7.0 Areas Identified for Further Foreign Technical Assistance/Collaboration/Aid

7.1 *Areas for foreign technical assistance*

Three areas have been identified for each IIT to be developed into Centres of Excellence through possible foreign technical assistance. These areas are indicated below :—

IIT, Delhi :	(1) Energy Studies (USA, France, Australia). (2) Automation & Process Control (USA, UK). (3) Bio-conversion & Bio-chemical Engineering (USA, UK, France, Switzerland & UN agencies).
IIT, Kanpur :	(1) Material Science & Engineering (USA, UK). (2) Laser & Laser Systems (USA, France, USSR, UK). (3) Computer Aided Design & Manufacture of Engineering Systems (UNDP, USA).
IIT, Madras :	(1) Ocean Engineering (FRG, France). (2) Urban Technology & Transportation Engineering (UK, USA, FRG, Japan). (3) Information Sciences (FRG, USA, France).
IIT, Bombay :	(1) Resource Engineering (USA, FRG). (2) Environmental Engineering (USA, FRG, Canada, Japan). (3) Powder Metallurgy & High Temperature Material Technology (USSR, UK, France).
IIT, Kharagpur :	(1) Cryogenics Engineering (UK, Canada, FRG). (2) Micro Electronics (UK, USA, France). (3) Food Processing & Post Harvest Technology (USA, Japan).

The areas mentioned first constitute continuation of the Advanced Centres which were set up during the Fifth Five Year Plan on the recommendations of the Nayudamma Committee. These Centres of Excellence have just taken off the ground in terms of creating necessary physical facilities and infrastructure and recruitment of core staff. In the next few years these Centres are expected to carry out many of the objectives that were set forth for them. It is, therefore, important to give top-most priority to these Advanced Centres. These Advanced Centres involving front-line Science and Technology are yet to be consolidated in the country and would, therefore, greatly benefit from having selective foreign technical assistance. These Centres should be evaluated at regular intervals to ensure that they fulfil the objectives set forth for them.

In order of priority, two more Areas have been identified for each IIT which again are of very much relevance to the National Science and Technology Scheme. These Areas have been identified on the basis of the following criteria :—

(a) Importance of the area to national development ;

(b) Physical facilities already available in the Institute ;

(c) Core-Faculty (number of professors and experts available in the Area) ;

(d) The Quantum of research already done in the Area.

The quantum of financial inputs that would be required over a period of 5 years for developing the above three Centres of Excellence in each IIT (as estimated by the IITs) is given in Table I.

TABLE I

	Funds required		Visits of Foreign Experts (Man-months)	Visits of IIT Faculty (Man-months)
	In Rupees (In lacs)	F.E. (In lacs)		
1	2	3	4	5
1. *IIT, Delhi*				
1. Energy Studies*	30.00	25.00	50	150
2. Automation & Process Control	100.00	100.00	40	120
3. Bio-Conversion & Bio-Chem	92.50	25.00	12	45
2. *IIT, Kanpur*				
1. Material Science*	48.00	85.00	30	30
2. Laser & Laser Systems.	75.00	62.00	30	30
3. Computer Aided Design & Manufacture of Engineering Systems**	151.00	183.00	30	120
IIT, Madras				
1. Ocean Engineering*	143.00	20.00	25	50
2. Urban Technology & Transportation Engineering	260.00	78.00	25	50
3. Information Sciences	39.00	80.00	25	50
4. *IIT, Bombay*				
1. Resources Engineering*	80.00	30.00	10	13
2. Environmental Engineering	200.00	50.00	20	45
3. Powder Metallurgy	200.00	80.00	20	45
5. *IIT, Kharagpur*				
1. Cryogenics Engineering*	75.00	135.00	12	36
2. Micro Electronics	40.00	40.00	9	36
3. Food Processing & Post Harvest Technology	40.00	40.00	12	36

*Continuing Centres.

**Proposal for this Centre is under active consideration by UNDP.

These requirements are to be carefully examined by a National Screening Committee (as recommended in para 8.5.1 in this report) in consultation with relevant Government Departments and other agencies. In their joint document, the IITs have given broad outlines of various projects proposed to be undertaken in these areas (vide Sl. No. 24, Annexure II).

Although certain areas have been identified for each IIT, it should be understood that work in these areas is also being done in other IITs and should be encouraged. In a vast country like ours, expertise has necessarily to be spread all around and good work done by different groups in various parts of the country.

7.2 *Areas for foreign collaboration*

In addition to the Areas of Excellence identified above, there are several other areas in each IIT which need to be strengthened in view of the expertise already existing. These areas again are very relevant to the National Science and Technology Scheme. The

areas which may be considered for support through foreign collaboration are listed in Table II.

TABLE II

DELHI	KANPUR	MADRAS	BOMBAY	KHARAGPUR
Polymer Science & Technology	Climatology & Monsoon Study	Polymer Technology	Petroleum Engineering	Bio-Engineering
Opto-Electronics & Optical Communication	Rural Communications	Bio-Medical Engineering	Corrosion Engineering	Coal Process Engineering
Atmospheric Sciences	Photo-Chemistry	Modern Machine Tools Technology	Systems & Control Engineering	Rubber Technology
Bio-Medical Engineering	Randum Vibrations & Acoustics	Television	Polymer Science & Engineering	Vibration & Noise Control
Systems Engineering	Kinetics & Catalysis	Refrigeration & Air-Conditioning	Solar Energy	Acqua-Culture Engineering

7.3 *Areas for foreign capital aid*

The IITs need foreign aid (as distinct from foreign collaboration or technical assistance) by way of budgetary support to replace old obsolete equipment and to consolidate and further develop areas (vide para 3.3) in which they have already acquired expertise of international standard on a continuing basis. The foreign aid requirements of the 5 IITs for the next 5 years (1980—85) have been estimated by them as given below :—

	Rupees in lakhs	Remarks
IIT, Delhi	300	This includes Rs. 6 lakhs of aid for spares already agreed under IIT, Delhi—UK Collaboration Agreement (1979—81).
IIT, Kanpur	300	
IIT, Madras	250	This includes Rs. 100 lakhs for spares/replacement under IIT Madras—FRG Collaboration Agreement.
IIT, Bombay	300	
IIT, Kharagpur	1200	Already under consideration of the Government.

8.0 Some Aspects and Corollaries

8.1 *Emerging areas of national relevance*

In the course of its work, the Committee made an attempt to identify emerging scientific and technological areas which are of national relevance and on which institutions like the IITs should concentrate. This meant spelling out in an integrated manner the areas of S&T relevance for the future cutting across the requirements of more than a dozen sectors and covering the programmes of about 25 departments/agencies in the Central Government. References were made to some of these agencies. The Annual Plan (1979-80) programmes and the Five Year Plan (1978—83) programmes of the various departments were examined. The result of this exercise is given in Annexure XIII. This list is only indicative and by no means exhaustive. It will be seen that the areas indentified for development in the various IITs are among the emerging areas of national relevance.

8.2 *Technical assistance from the IITs to other technical institutions and developing countries*

All the IITs have expressed their readiness to offer technical assistance—sans financial support—to other technical institutions such as engineering colleges in any of the following forms :

1. Design and setting up of modern laboratories and workshops including advice on choice of equipment, instruments, etc.
2. Training of faculty and staff of Engineering Colleges in IITs in specific areas.

3. Deputing IIT faculty and staff to other institutions for specific assignments.
4. Development of curricula, syllabi, courses, etc.
5. Advisory services on any aspect of technical education and training.
6. Development of consultancy services.
7. Establishment of R&D centres.
8. Conducting joint research projects and academic courses.
9. Offering out-dated but useful equipment.

The IITs at Delhi and Madras have worked out specific schemes to offer technical assistance to engineering colleges in their respective regions. Some time ago the IIT Delhi had sent teams of their faculty to negotiate possible special relationships with Regional Engineering College Srinagar, Punjab Engineering College, Chandigarh, Aligarh Muslim University, Aligarh and Regional Engineering College, Kurukshetra. In August 1976, the IIT Madras drew up a concrete plan of action for its collaboration with eight engineering colleges in the Southern Region in consultation with the Principals of the colleges concerned. Somehow, the idea has not yet caught up. There is a lot of scope and need for the flow of technical assistance from the IITs to other institutions. Some of the bottlenecks in the way are : budgetary restrictions, rigid academic controls by the universities, lack of adequate faculty/staff training reserves, etc. These bottlenecks should be removed.

It is seen that many engineering colleges and university technological departments often make applications for foreign technical assistance in areas where such technical assistance can easily be given by the IITs. At least in future such applications should be carefully screened with a view to fully utilising the technical expertise and competence of the IITs.

The IITs are also prepared to offer technical assistance to other developing countries. A few foreign universities have already approached some IITs for such assistance. The Educational Consultancy Company, which is proposed to be set up by the Government of India would do well to draw upon the expertise and competence of the IITs in its main task of offering educational consultancy services to the developing countries.

8.3 *Assessment and transfer of technology*

At present there is no centralised agency to assess the technologies available and needed at any point of time. Many R&D projects that are undertaken in the various academic institutions including the IITs remain at the laboratory stage. There is need to establish Centres for assessment and transfer of technology. These Centres should critically evaluate the available technologies and provide choices for the national leaders to take rational decisions. Many industries in advanced nations have gone through such transfers of technology created in educational institutions, for example, the industrial complex around Massachussetts Institute of Technology (MIT) or at Stamford University.

8.4 *Training in instrumentation*

Instrumentation is becoming more and more sophisticated incorporating latest technologies. The technicians are not in a position to keep up with these developments because of lack of training facilities. These training programmes have to be of a continuing nature, incorporating latest developments in instrumentation technology. Unless this is done with concerted effort, it will not be possible to effectively maintain and utilise the sophisticated equipment that the Institutes possess or will acquire in future. It is necessary to create in the IITs an infra-structure for training in the instrumentation area, with particular reference to repairs and maintenance of sophisticated equipment. Every IIT should ensure that it is capable of maintaining and repairing its own equipment and those

of others in that region. In this endeavour, the IITs should cooperate with the CSIO and also with the Regional Sophisticated Instrument Centres (RSICs) set up by the Department of Science & Technology.

8.5 *Guidelines for considering proposals for foreign aid/collaboration/technical assistance*

Various national and international forums including the Pagwash Council and UNCSTD (1979) have discussed the theme of guidelines for international scientific cooperation for development and have made detailed recommendations. For the limited purposes of this report, the following suggestions are made :—

8.5.1 Proposals for foreign technical assistance/collaboration/aid received from the IITs etc. cannot—and should not—be considered in isolation. All such proposals should be screened by a National Screening Committee in the Ministry of Education. Apart from the Chairman, the Committee should consist of one representative each from the Ministry of Education, Planning Commission, Department of Science & Technology and the Department of Economic Affairs at appropriate levels. Depending upon the subject area of the proposals under consideration, the Committee may invite for its meetings representatives of relevant departments/agencies such as Electronic Commission, Indian Council of Agricultural Research, Ministry of Energy, etc., to come to decisions based on national priorities and perspectives. If need be, the proposals could be referred to a small group of Experts before they are considered by the National Screening Committee. Representatives of Industry may also be involved in this exercise.

8.5.2 Indiscriminate and uncoordinated use of foreign technical assistance programmes—as has been happening so far—should be put an end to. It is unrealistic and unproductive to base development strategies on the availability of massive foreign "aid" (financial, scientific and technological). Foreign technical assistance should be sought only on selective basis for (i) new and emerging areas where adequate expertise does not exist, (ii) for academic exchanges in advanced areas where it is important for our Centres of Excellence to maintain close inter-action with their counterparts elsewhere, and (iii) for procuring sophisticated equipment which are not indigenously available. In all cases, it should be ensured that the proposals have relevance to the overall national priorities and commitments. Agencies like the NCST, DST, CSIR etc. should identify national needs and priorities and define tasks to be undertaken as national S&T projects.

8.5.3 Proposals for foreign technical assistance should be scrutinised from the point of view of ensuring that in the area concerned our dependence on foreign expertise does not get perpetuated. The objective should be to develop indigenous capabilities and self-reliance. Such proposals should not promote the participation of foreign experts or advisers who are not needed; preference should always be given to Indian advisers and experts or in temporary conjunction with absolutely needed foreign counterparts. Mechanisms other than "expert-equipment-training" packages should be sought.

8.5.4. In all collaborative programmes, formulation of projects, decision making, managerial and evaluation functions etc. should always be retained in the hands of the local experts, even if there is need for initial training.

8.5.5 Cooperative projects should never be conceived as a replacement of existing indigenous endeavours. If such endeavours are inadequate in scope or quality, any collaboration should be directed towards their strengthening and upgrading and not their elimination or undermining.

8.5.6 In all programmes the flow of funds from outside agencies should invariably be routed through or with the approval of the national authorities concerned.

8.5.7 At present several agencies including Government departments are deputing hundreds of their personnel for training abroad in areas where training facilities are available in the country. It is necessary to screen all the training programmes through the National Screening Committee. Even in many of the emerging areas, major part of the training could be given in India. Preparatory training methodology has to be introduced with a view to utilising the components of training facilities indigenously available and maximise the benefits from foreign training.

8.5.8 It should be ensured that foreign experts/consultants are obtained only for absolutely essential areas of gaps in technology and that too for the minimum possible periods. It should be remembered that really good experts are busy people and would be available only for short durations. At the same time, free flow of experts between India and other countries should be encouraged on equal partnership basis. It would be good for technical institutions to share their foreign experts with industry and vice versa.

8.5.9 In all foreign technical assistance programmes the requirements of equipment and instrumentation should be carefully scrutinised to ensure that equivalent indigenous supplies and stores are fully utilised. Where instruments/equipment are not locally available, indigenous development of such instruments and equipment should be encouraged to meet future requirements.

8.5.10 Institutions of the same category should coordinate their foreign technical assistance/aid requirements and submit their proposals jointly preferably in August every year. For example, the IITs should consult each other and give agreed proposals jointly. The same could be done by the Indian Institutes of Management, Regional Engineering Colleges etc. The requirements of Universities/University Departments could be coordinated by the UGC and then sent to the National Screening Committee for consideration.

8.5.11 Before they enter into any foreign collaboration, the research organisations and technical institutions in India should cooperate among themselves and explore the facilities and competence available within the country. All funding agencies should promote and foster trans-disciplinary approach and trans-organisational activity maximising utilisation of available resources, facilities and talents within the country.

9.0 Findings and Recommendations

9.1 The amount of foreign technical assistance/aid so far received by the 5 IITs (as on 1-1-1979) may be quantified as equal to about Rs. 24 crores worth of equipment, 5202 man-months of Indian faculty training abroad and 8166 man-months of foreign experts in the IITs. The figures in respect of 17 non-IIT institutions are roughly Rs. 5.5 crores, 1781 man-months and 2836 man-months respectively. The non-recurring Indian capital input into the 5 IITs has been of the order of Rs. 58 crores. (2.1, 2.2, 4.0).

9.2 Foreign technical assistance has had a significant impact on the IITs and in turn on the technical education system in the country. It has helped the IITs to develop expertise at international levels and to build up competent R&D infrastructure in a wide variety of scientific and technological fields. The IITs have also been able to produce about 35,000 engineers, scientists and technologists of high calibre. (3.1, 3.2, 3.3, 3.4, 3.6).

9.3 Fifteen (15) areas have been identified (3 for each IIT) for possible further foreign technical assistance. These areas which are relevant to the national needs may be developed into "Centres of Excellence". In these areas, the IITs should inter-act with their counterparts in foreign countries on a continuing basis to reduce the temporal phase-lag in developing these areas in our country. (7.1, 8.1).

9.4 Twenty five (25) other areas have been identified (5 for each IIT) which may be considered for foreign collaboration on equal partnership basis. These are all emerging areas and have national perspectives. Foreign collaboration is considered necessary to maintain the levels of research and development in these areas at international levels. (7.2, 8.1).

9.5 The IITs will need foreign capital aid (as distinct from foreign technical assistance or collaboration) by way of budgetary support to replace old obsolete equipment and to consolidate and further develop areas in which they have already acquired expertise of high standards in case adequate internal resources (including necessary foreign exchange component) are not available for these purposes. (3.3, 5.1, 7.0, 7.3).

9.6 The so-called obsolete equipment in good working condition should be transferred from the IITs to the other needy institutions.

A small team of competent instrument mechanics/experts should be asked to examine the sophisticated equipment now lying idle in the various IITs with a view to setting them right. If it is necessary to import spares, this should be done as a matter of urgency.

It is necessary to create in the IITs an infrastructure for training in the instrumentation area with particular reference to repairs and maintenance of sophisticated instruments. (5.1, 5.2, 8.4).

9.7 It is unrealistic and unproductive to use foreign technical assistance/collaboration/aid programmes indiscriminately and in an uncoordinated manner. These programmes should be used only on a selective basis for new and emerging areas, for inter-action in areas of excellence and for procuring sophisticated equipment not available indigenously. In all these cases, the proposals should be based on overall national priorities and commitments. (6.0, 7.1, 7.2, 7.3, 8.5.2, 8.5.11).

9.8 No foreign technical assistance programme should be such that it would perpetuate our dependence in the area concerned on foreign expertise and support. The objective should always be to develop indigenous capabilities and self-reliance. In all programmes, formulation and management of the projects, decision taking, evaluation etc., should be our responsibility. Mechanisms other than "expert-equipment-training" should be sought. (8.5.3, 8.5.4).

9.9 Foreign technical assistance/collaboration/aid programmes should not be aimed at replacing existing indigenous endeavours; they should be directed to strengthening and upgrading them. (8.5.2, 8.5.3, 8.5.5, 8.5.11).

9.10 Proposals for foreign technical assistance/collaboration/aid received from the IITs and other academic institutions should not be considered in isolation. They should be considered on the basis of overall national perspectives and in relation to what is happening in other departments (such as Electronics, Science and Technology, Space, etc.) and agencies (such as CSIR, ICAR, ICMR, etc.). It is, therefore, suggested that all proposals for foreign technical assistance should be considered by a National Screening Committee in the Ministry of Education and with representatives from the Ministry of Education, Planning Commission, Department of Science and Technology and Department of Economic Affairs. This Committee could invite for its meetings representatives from other departments and agencies depending upon the subject areas of the proposals under consideration. (8.5.1, 8.5.2).

9.11 In all foreign technical assistance/collaboration programmes, the flow of funds from foreign agencies should be with the full knowledge of and/or through the national authorities. (8.5.1, 8.5.6, 8.5.11).

9.12 It is necessary to review the foreign training programmes of various agencies including Government departments. Even today, a large number of people are being unnecessarily sent abroad for training in areas for which ample facilities are available in India. Even in emerging areas, it is possible to give major part of the training in India ; such preparatory training in India would greatly enhance the benefits from foreign training inputs. (3.2, 5.4, 8.5.2, 8.5.7).

9.13 Foreign experts/consultants should be obtained only for absolutely essential areas of gaps in technology and that too only for short periods. But at the same time there should be a free flow of experts between India and other countries on equal partnership basis. Only sophisticated equipment/instruments which are not available indigenously should be included for import under foreign technical assistance programmes. Efforts should always be to develop such equipment/instruments in India. (5.2, 5.3, 8.5.2, 8.5.8, 8.5.9).

9.14 Institutions of the same category like the IITs should consult each other and submit to the National Screening Committee coordinated and agreed proposals for foreign technical assistance/collaboration aid preferably in August every year. Institutions like the Indian Institutes of Management and Regional Engineering Colleges could also do the same. (8.5.2, 8.5.10, 8.5.11).

9.15 There is a remarkable increase in the number of sponsored research projects undertaken by the IITs. These projects are done on a no-loss no-profit basis. It is suggested that the IITs may be allowed to generate funds from sponsored research programmes on the basis of norms of charges to be laid down by the appropriate authorities.

The IITs should not undertake routine testing jobs in the name of consultancy. (3.4).

9.16 The IITs should not work in isolation. They should build up and increase formal linkages with other academic institutions, R&D organisations and national laboratories. (3.5, 8.2, 8.5.11).

9.17 The IITs are competent and willing to give assistance—sans financial support—to institutions of lower formations in a variety of ways. Concrete steps should be taken to promote the flow of such technical assistance from the IITs to engineering colleges etc. The expertise available in the IITs to offer consultancy services should be fully utilised by the Educational Consultancy Company proposed to be set up under the auspices of the Government of India. (3.2, 3.3, 3.4, 8.2).

9.18 There is need to establish in the IITs Centres for Assessment and Transfer of Technology. (8.13).

Sd/-
(Prof. Y. Nayudamma)
Chairman

Sd/-
(Prof. C. S. Jha)
Member

Sd/-
(Shri J. A. Kalyanakrishnan)
Member

Sd/-
(Shri K. R. Sivaramakrishnan)
Member

Sd/-
(Dr. K. Gopalan)
Member—Secretary

Annexures : I to XIII.

New Delhi : 18-12-1979.

Proforma to evaluate and review foreign aid/technical assistance so far received

1.1 Please give details of foreign AID (as distinct from technical assistance) so far received. Please indicate the purpose for which aid was received, the programme under which it was received, nature and quantity of aid (in equivalent rupees) and other particulars year-wise since inception of your institution.

1.11 Is there any foreign AID (as distinct from technical assistance) still in the pipeline? Please give details.

1.2 Please give details of foreign technical assistance (as distinct from AID) so far received. Please give the purpose, the scheme under which it was received, nature and quantity of assistance (in equivalent rupees), number of foreign experts who served your institution (in man-months), number of your faculty who were trained abroad (in man-months), areas in which foreign technical assistance was received, etc. year-wise since inception of your institution.

1.21 Is there any foreign technical assistance (as distinct from AID) still in the pipeline? Please give details.

2.1 Please explain the impact of foreign aid/technical assistance on your institution with details of expertise and capabilities developed at national and international levels.

Please specify the impact on under-graduate/post-graduate programmes, research and development activities, sponsored projects, consultancy activities etc.

Did the donor Government's educational policy have any influence in shaping the educational policy of your institution? Please specify.

2.2 Has foreign aid/technical assistance created any problems in your institution? What are they?

2.21 How acute is the problem of spares for imported equipment got through foreign aid/technical assistance? Which are the items and types of equipment lying un-used because of lack of spares? Please quantify.

2.22 Have there been any restrictions on the source/purchase of equipment under foreign aid/technical assistance programmes? Give details.

2.3 Have the faculty/experts sent by donor Governments been of the right calibre? Did you have a say in their selection? How do you rate their contribution to the development of your institution ?

2.4 Were your staff/faculty deputed abroad satisfied with their training ? Do you have any suggestions in this regard ?

3.1 Identify gaps that still exist in your institution. What is the sort and magnitude of foreign aid/technical assistance that you still need to fill these gaps during the next 5—10 years? Please specify the area, your requirements of equipment, foreign experts (in man-months), foreign training (in man-months) etc.

3.2 Identify for your institution five major areas where adequate expertise is not available in the country. How and why do you think that these areas are important?

3.21 Which are the countries you would like to associate with to develop the above areas in your institution? Give reasons.

3.22 Indicate the quantum of assistance that you need in the above areas by way of equipment, foreign experts, foreign training, etc.

4 In the light of your past experience, what working model would you suggest for future collaboration with foreign countries?

5 What expertise and technical assistance can you offer to other developing countries? Do you specify any conditions? What are they?

6 What expertise and technical assistance (other than QIP Programmes) can you offer to other technical institutions such as engineering colleges, polytechnics, etc. in this country? Do you specify any conditions? What are they?

List of references

1. Draft Five Year Plan 1978-83.
2. Proposals for Five Year Plan 1978-83 and Annual Plan 1978-79 of the Indian Council of Agricultural Research.
3. Draft report of the sub-group on S&T programme under the main Working Group on major and minor irrigation and flood control.
4. Annual Plan 1979-80 of the Indian Council of Medical Research.
5. Five-Year and Annual Plan documents 1978-83 & 1979-80 respectively of the Indian Meteorological Department & Institutes.
6. Five-Year and Annual Plan documents 1978-83 & 1979-80 respectively of the Department of Coal.
7. Annual Plan 1979-80 of the Department of Power.
8. Sub-group report on R&D and Five-Year Plan documents 1978-83 of the Department of Petroleum.
9. Working Group report on Housing for the formulation of Five-Year Plan 1978-83.
10. Working Group report on Fertilizer for Five-Year Plan 1978-83.
11. Working Group report on Organic Chemicals for Five Year Plan 1978-83.
12. Working Group report on Inorganic Chemicals for Five Year Plan 1978-83.
13. Electronics Information & Planning 1978-83.
14. Industrial R&D Plans for Iron & Steel.
15. Five Year Plan document 1978-83 of the Department of Space.
16. Five Year Plan document 1978-83 of the Department of Atomic Energy.
17. Five Year Plan document 1978-83 of the CSIR.
18. Five-Year and Annual Plan documents 1978-83 & 1979-80 of the Department of Mines.
19. Report of the Working Group on Petro-Chemicals.
20. Report of the Interministerial Committee on Oceanographic Research and Development (1974-79).
21. NCST Plan (1974-79) document Vol.-II.
22. UNDP Project document of NIH.
23. 'Foreign-aided IIT education' by Sheilu Sreenivasan.
24. Joint document of IITs for foreign technical assistance and collaboration and establishment of centres of excellence : August 1979.
25. 'Guidelines for international scientific cooperation for development' : Pugwash Conference on Science and World Affairs. Geneva, May 1978.

Quantum of foreign aid/technical assistance received by the IITs till 1. 1. 1979

IIT	Scheme	Equipment (Rs. in lakhs)	Guest faculty from abroad		Indian faculty training abroad		Remarks
			No.	Man-months	No.	Man-months	
1. Delhi (Estd. : 1961)	1. Indo-U.K. Collaboration	575.00	184	1072	144	1895	Collaboration is continuing.
	2. Indo-Swiss Collaboration	19.00	7	25	7	46	-do-
	3. Indo-Norwegian Collaboration	6.59	2	2	7	18	-do-
	4. Indo-French C.E. Programme	8.00	21	15	17	79	-do-
	5. P. L. 480	9.75	—	—	—	—	
	6. Other Programmes	4.67	—	—	—	—	
Total	6. Schemes	623.01	214	1114	175	2038	
2. Kanpur (Estd. : 1960)	Kanpur Indo-American Programme	373.19	120	2226	49	500	Programme from 1962 to 1972
3. Madras (Estd. : 1959)	1. Indo-German Collaboration	1025.00	75	2254	117	1264	Collaboration continuing.
	2. Irish Government Equipment Aid	21.00	—	—	—	—	1974
	3. Indo-French C.E. Programme	—	Brief stray visits		6	36	Collaboration continuing.
Total	3 Schemes	1046.00	75	2254	123	1300	
4. Bombay (Estd. : 1958)	1. Unesco Aid Programme (Old Rouble Currency Funds)	171.00	82	1512	27	810	Programme from 1958 to 1966.
	2. Indo-USSR Collaboration	60.00	54	840	—	—	Collaboration was from 1966 to 1970.
Total	2 Schemes	231.00	136	2352	27	810	

IIT	Scheme	Equipment (Rs. in lakhs)	Guest faculty from abroad		Indian faculty training abroad		Remarks
			No.	Man-months	No.	Man-months	
5. Kharagpur (Estd. : 1950)	1. Indo-USSR Credit Agreement : 1966	29.58		102		120	Collaboration concluded.
	2. 12 Million Dollar USA Equipment Fund	17 26		—		—	1970–72.
	3. T.C.M. Equipment Fund	39.67		60		387	1952–59.
	4. Alexander-Von-Humboldt Foundation Equipment Aid	2.93		—		—	
	5. Colombo Plan 1952–59	7.30		12		63	1952–59.
	6. Ford Foundation Fund	9.92		46		90	
Total	6 Schemes	106.66		220		560	

Foreign aid/technical assistance in the pipe-line as on 1.1.1979 (for the IITs)

IIT	Scheme	Rs. in lakhs	Remarks
1. Delhi (1961)	1. Indo-U.K. Collaboration	9.00	Several other proposals under P.L. 480, UNDP, etc. have been submitted.
	2. Indo-Swiss Collaboration	7.00	
	3. Indo-Norwegian Collaboration	10.00	
	4. P. L. 480	22.00	
	5. Ford Foundation	7.00	
Total		55.00	
2. Kanpur (1960)	Nil	Nil	
3. Madras (1959)	Indo-German Collaboration	—	The present (4th) Agreement has been extended up to the end of 1979. Proposals for the next Agreement are under formulation.
4. Bombay (1958)	1. British Technical Assistance for Offshore Engg. Programme	15.00	Expected to be finalised in 1979.
	2. UNDP Aid for IDC	30.00	Operational from 1-1-1979.
Total		45.00	
5. Kharagpur (1950)	1. British Technical Assistance for Modernisation of Labs Workshops.	280.00	Expected to be finalised in 1979.
	2. British Technical Assistance for Naval Architecture.	15.00	-do-
Total		295.00	Several other proposals for Technical assistance from UK, USA, Japan etc have been ubmitted.

ANNEXURE V

Areas of expertise and competence developed in the various IITs at National and International levels

Indian Institute of Technology : Delhi (Estd: 1961)

S. No.	Area	Faculty Members
1.	Structural Engineering	Prof. A. K. Basu Prof. B. M. Ahuja Prof. K. Seetharamulu Prof. S. Krishnamurthy Dr. C.S. Surana Shri M. Raghupati Dr. K.K. Nayar Dr. T. K. Datta Dr. S.N. Sinha Dr. A. K. Nagpal
2.	Soil Mechanics	Prof. S. K. Gulhati Prof. T. Ramamurthy Dr. K. Kaniraj Dr. G.V. Rao Dr. A. Vardarajan Shri K.K. Gupta Dr. G.G. Prabhakar Narayanan Dr. J.M. Kala
3.	Water Resources	Prof. Saranjit Singh Prof. Subhash Chander Prof. M. C. Chaturvedi Prof. P. S. Satsangi Dr. P. Natrajan Dr. S. K. Spolia Dr. P. N. Kapoor Dr. T. Karunakaran Dr. A. K. Sinha Dr. K. K. Biswas Dr. Suresh Chandra
4.	Automatic Control Engineering	Prof. A. K. Mahalanabis Prof. V. S. Rajamani Prof. S. S. Lamba Dr. A. K. Sinha Dr. K. K. Biswas Dr. S. Vittal Rao Dr. B. N. Jain Dr. S. I. Ahson
5.	Communication Engineering	Prof. R.K. Arora Prof. B. Bhatt Dr. S.N. Gupta Shri V. N. Sharma Dr. S.C. Kak Dr. H. M. Gupta Dr. Surender Prasad Dr. S. S. Jamuar Dr. B. B. Madan Dr. (Mrs.) K. Arora Dr. R. C. Aggarwal Dr. Vinod Chandra

S. No.	Area	Faculty Members
6.	Systems Engineering	Prof. P. S. Satsangi
		Prof. A. K. Mahalanabis
		Prof. M. C. Chaturvedi
		Dr. B. N. Jain
		Dr. T. Karunakaran
		Dr. C.V. Ramakrishnan
		Prof. P. C. P. Bhatt
		Dr. J.G. Deshpande
		Dr. A. K. Sinha
		Dr. V. N. Arora
		Dr. V. Gautam
		Dr. W. Shukla
		Dr. Suresh Chandra
		Prof. Prem Vrat
		Dr. Kiran Seth
		Mr. Arun Kanda
		Prof. R. K. Arora
		Mr. T. K. Kundra
7.	Integrated Circuit Technology	Prof. S. C. Duttaroy
		Prof. A. B. Bhattacharyya
	Power Systems and Machines	Prof. C. S. The
		Prof. R. Arockiasamy
		Prof. J. Nanda
		Prof. C. S. Indulkar
		Prof. S. C. Tripathy
		Dr. J. K. Chatterjee
		Dr. S. S. Murty
		Dr. Joseph Henry
		Dr. C. M. Bhatia
		Dr. B. P. Singh
		Dr. K. S. P. Rao
		Dr. D.P. Kothari
9.	Chemical Reaction Engineering	Prof. M. K. Sarkar
		Prof. P. D. Grover
		Prof. P. N. Sehgal
		Dr. A. K. Gupta
		Dr. D. Subba Rao
		Dr. D. P. Rao
		Dr. T. R. Rao
		Dr. A. K. Sachdeva
		Dr. K. P. P. Nigam
10.	Renewable Resource Engineering and Bio-Conversion	Prof. T.K. Ghose
		Dr. S. N. Mukhopadhya
		Dr. K. Das
		Dr. P. Ghose
11.	Bio-Chemical Engineering	Dr. Subhash Chander
		Dr. V. S. Bisaria
		Dr. R. D. Tyagi
		Dr. V. Sahai
12.	Thermal Engineering	Prof. H. B. Mathur
		Prof. C. P. Arora
		Prof. S. M. Yahya
		Dr. R. D. Garg
		Dr. O. P. Chawla
		Dr. R. R. Gaur
		Dr. P. L. Dhar
		Dr. D. P. Aggarwal
		Shri J. P. Subrahmanyam
		Dr. O. P. Dhiman
		Dr. P. B. Sharma

S. No.	Area	Faculty Members
13.	Machine Dynamics and Industrial Tribology	Prof. J. P. Sharma Prof. B. C. Nakra Prof. J. S. Rao Lt. Gen. M. M. L. Chhabra Dr. O. P. Chawla Dr. N. T. Asnani Dr. S. Biswas Dr. K. K. Pujara Dr. K. N. Gupta Dr. Raghavacharyulu Dr. C. R. Jagga Shri K. L. Awasthy Shri Arun Parkash Shri O. P. Gandhi Shri K. Attre Shri Om Parkash
14.	Production and Industrial Engineering	Prof. Prem Vrat Prof. B. L. Juneja Shri J. M. Mahajan Dr. Kiran Seth Shri A. D. Gupta Shri Arun Kanda
15.	Fibre Science Technology.	Prof. V. B. Gupta Prof. D. S. Verma Prof. A. K. Sengupta Dr. A. K. Mukherjee Dr. C. D. Shah Dr. B. L. Deopura Dr. A. Mishra Dr. A. K. Gupta
16.	Textile Engineering	Prof. N. M. Swani Prof. A. K. Sengupta Dr. B. Dutta Dr. P. K. Hari Dr. R. C. Mahindru Dr. Amrik Singh Shri V.K. Aggarwal Dr. V. K. Kothari
17.	Solid State Materials Devices including Thin Film Technology	Prof. K.L. Chopra Prof. A. B. Bhattacharyya Prof. P.K.C. Pillai Prof. B.B. Tripathi Dr. L.K. Malhotra Dr. T.C. Goel Dr. S. C. Kashyap Dr. V. D. Ventan Dr. S. D. Sharma Dr. O. P. Agnihotri Dr. V. Ramamurthy Dr. L. M. Tewari Dr. M. P. Verma Dr. D.C. Dube Dr. K. P. Jain Dr. S. C. Mathur Dr. R.G. Mendiratta Dr. R. K. Puri Dr. H. K. Sehgal Dr. D. P. Tewari Dr. D. K. Roy Dr. S. K. Sharma

S. No.	Area	Faculty Members
18.	Polymer Science and Technology	Prof. V. B. Gupta
		Prof. (Mrs.) I. K. Verma
		Dr. A. Mishra
		Dr. (Mrs.) P. Bajaj
		Dr. A. K. Mukherjee
19.	Bio-Medicai Engineering	Prof. S. K. Guha
		Dr. S. N. Tondon
		Dr. (Mrs.) P. Vasudevan
		Dr. V. K. Goel
		Dr. (Miss) S. Anand
		Dr. A. K. Ray
		Dr. S. Mahajan
20.	Numerical Analysis	Prof. M. K. Jain
		Prof. M. M. Chawla
		Prof. K. D. Sharma
		Prof. R. K. Arora
		Dr. S. R. K. Iyenger
		Dr. R. K. Jain
		Dr. Ravinder Kumar
		Dr. (Mrs.) Raj Ahuja
		Dr. (Mrs.) Prabhat Shobha
21.	Information Sciences	Prof. M. K. Jain
		Prof. N. S. Kambo
		Prof. P. G. Reddy
22.	Applied Mathematics	Prof. M. P. Singh
		Prof. O. P. Bhutani
		Dr. K. N. Mehta
		Dr. Prem Kumar
23.	Physical Chemistry	Prof. J. C. Ahluwalia
		Dr. G. Basu
		Dr. A. S. N. Murthy
		Dr. L. D. Ahuja
		Dr. N. K. Sandle
		Dr. S. K. Suri
		Dr. (Mrs.) P. Vasudevan
		Dr. B. Chawla
24	Applied Optics	Prof. P. K. C. Pillai
		Prof. C. L. Mehta
		Prof. M. S. Sodha
		Prof. A. K. Ghatak
		Shri Kher Singh
		Dr. R.N. Singh
		Dr. S. Chopra
		Dr. K. Thyagarajan
25.	Opto-Electronics and Optical Communications	Prof. P. K. C. Pillai
		Prof. A. K. Ghatak
		Prof. M. S. Sodha
		Dr. I.C. Goyal
		Dr. Arun Kumar
		Dr. K. Thyagarajan
		Dr. S. C. Abbi
		Dr. S. Chopra
26.	Solar Energy	Prof. M. S. Sodha
		Prof. S. S. Mathur
		Prof. S. P. Sabberwal
		Dr. H. P. Garg
		Dr. S. C. Mullick
		Dr. S. C. Kaushik
		Dr. D. K. Pandya
		Dr. Ashok Malhotra

Indian Institute of Technology : Kanpur (Estd: 1960)

S. No.	Area	Faculty Members
1.	Environmental Engineering	Dr. A. V. S. Prabhakararao
		Dr. Malay Choudhary
		Dr. S. D. Bokil
		Dr. C. Venkobachar
		Dr. V. Lakshminarayana
		Dr. S. Rameseshan
		Dr. G. N. Rao
		Dr. P. S. Goel
2.	Modern Area of Chemistry	Dr. P. T. Narasimhan
		Dr. M. V. George
		Dr. P. S. Goel
		Dr. S. Ranganathan
		Dr. U. C. Aggarwal
		Dr. P. K. Ghosh
		Dr. S. Mukherjee
		Dr. P.N. Singh
		Dr. D. N. Dhar
		Dr. P. C. Nigam
		Dr. S. S. Katiyar
		Dr. P. Gupta Bhaya
3.	Signal Processing	Dr. P. K. Chatterjee
		Dr. S. K. Mullick
		Dr. P. R. K. Rao
		Dr. K. R. Sharma
		Dr. V. Sinha
		Dr. R. Subramanian
4.	Energy System (Photovoltaic cells)	Dr. S. Kar
		Dr. R. Sharan
		Dr. S. C. Agarwal
		Dr. D. K. Paul
5.	Energy Systems (Power Systems)	Dr. M. A. Pai
		Dr. R. P. Agarwal
		Dr. K. R. Padiyar
		Dr. S. Gupta
6.	Manufacturing Science	Dr. S. N. Bandoyapadhya
		Dr. J. L. Batra
		Dr. A. Bhattacharyya
		Dr. A. Ghosh
		Dr. G. S. Kainth
		Dr. G. K. Lal
		Dr. M. K. Muju
		Dr. A. Mullick

S. No.	Area	Faculty Members
7.	Process Metallurgy	Dr. N.K. Batra Dr. A. K. Biswas Dr. S. Chander Dr. A. Ghosh Dr. A. K. Jena Dr. P. C. Kapur Dr. S. P. Mehrotra Dr. H. S. Ray Dr. K. P. Singh Dr. E.C. Subbarao
8.	Aerodynamics (Low speed experimental aerodynamics)	Dr. A.K. Gupta Dr. K. Ghosh Dr. R.K. Sullerey
	Aerodynamics (Transonic flow)	Dr. N.L. Arora
	Aerodynamics (Hypersonic flow)	Dr. A.C. Jain Dr. R.N. Gupta
	Aerodynamics (Flight mechanics)	Prof. C. V. R. Murti Dr. S.C. Raisinghani Dr. M. Krishnamurthi

Indian Institute of Technology : Madras (Estd: 1959)

S. No.	Area	Faculty Members
1.	Machine Dynamics	Dr. B. V. A. Rao Dr. V. Ramamurthy Dr. C. R. Subramaniam Dr. N. Ganesan Dr. B. S. Prabhu
2.	Elasticity	Dr. R. S. Alwar Dr. R. S. Srinivasan
3.	Structural Engineering	Dr. P. Srinivasa Rao Dr. D. J. Victor Dr. L. N. Ramamurthy Dr. R. Radhakrishnan Dr. T. P. Ganesan Dr. C. S. Krishnamurthy Dr. V. Paramasivam Dr. C. Ganapathy Chettiar Dr. N. Rajagopalan
4.	Soil Mechanics	Dr. K. S. Sankaran Dr. V.S. Raju Dr. M.S. Subramaniam Dr. B. Ramanathan Dr. Nainan P. Kurian Dr. Dakshnamurthy
5.	Hydraulics	Dr. H. Raman Dr. R. L. Roy Choudhury Dr. K. Elango Dr. N. Jothi Sankar Dr. H. Suresh Rao
6.	Particulate Technology	Dr. Venkateswarlu D. Dr. T. Gopichand Dr. M. Ramanujam Dr. K. Remananda Rao Dr. A. Prabhakara Rao
7.	Reaction Engineering	Dr. M. Satyanarayana Dr. Y. B. G. Verma Dr. P. R. Krishnaswamy Dr. N. Subramanian Dr. T. Venkatram Dr. N. M. Raghavendra Dr. G. S. Davies Dr. M. S. Ananth Dr. Ch. Durgaprasada Rao Dr. R. Subramaniam
8.	Controls, Machines & Electrical Drives	Dr. P. Venkata Rao Dr. B. Ramaswamy Dr. V. V. Sastry Dr. G. Sridhara Rao Dr. Vedam Subramaniam Dr. V. Seshadri

S. No.	Area	Faculty Members
9.	Power Systems & High Voltage	Dr. M. Venugopal Dr. Y. Narayana Rao Dr. A. Kuppurajulu Dr. A. Chandrasekharan Dr. S. Elangovan Dr. C. Narayana Reddy Dr. C. Raman Nair
10.	Networks & Instrumentation	Dr. V. G. K. Murti Dr. V. V. Bapeswara Rao Dr. P. Sankaran Dr. P. Subbarami Reddy
11.	Production Engineering/Machine Tool/ Metrology	Dr. V. C. Venkatesh Dr. H. Chandrasekharan Dr. V. Radhakrishnan Dr. P. K. Philip
12.	Thermodynamics & Combustion Engineering/ Solar Energy	Dr. M. C. Gupta Dr. R. Natarajan Dr. K. A. Bhaskaran Dr. V. Sriramulu
13.	Metal Casting	Dr. M. Roshan Dr. V. Panchanathan Dr. O. Prabhakar Dr. E. G. Ramachandran
14.	Catalysis and Reaction Mechanism	Dr. J. C. Kuriacose Dr. V. Srinivasan Dr. V. Mahadevan Dr. R. Narayan Dr. K. Narayanan Dr. C. N. Pillai Dr. J. Rajaram Dr. V. Ramakrishnan Dr. T. V. Ramakrishna Dr. C. S. Swamy Dr. C. Kalidas Dr. M. V. C. Sastry Dr. B. Viswanathan
15.	Structural Chemistry	Dr. V. Aravamudhan Dr. M. S. Gopinath Dr. P. T. Manoharan Dr. S. R. Ramadas Dr. S. Subramaniam Dr. Surjit Singh Dr. M. R. Uduppa
16.	Stochastic Processes	Dr. S. K. Srinivasan Dr. K. R. Parthasarathy Dr. R. Subramanian
17.	Fluid/Continuum Mechanics	Dr. S. D. Nigam Dr. L. V. K. V. Sarma Dr. H. S. Paul Dr. V. Subba Rao Dr. U. N. Srivastava

S. No.	Area	Faculty Members
18.	Solid State Physics	Dr. C. Ramasastry Dr. R. Srinivasan Dr. V. Sivaramakrishnan Dr. J. Sobhanadri Dr. B. V. Ramanamurthi Dr. C. K. Narayanaswamy Dr. S. Swaminathan Dr. S. B. S. Sastry Dr. S. Radhakrishnan Dr. Y. V. G. S. Murthi Dr. R. Ramji Rao Dr. B. M. Siva Ram Dr. K. V. S. Rama Rao

Indian Institute of Technology : Bombay (Estd : 1958)

S. No.	Area	Faculty Members
1.	Aerodynamics testing and Analysis	Prof. S. K. Ojha Prof. S. L. Gai Dr. T. S. Patel Dr. B. M. Pamadi Dr. M. M. Sivaramakrishnan Dr. T. G. Pai Shri T. G. Shevare
2.	Mechanics of Composites and Structures	Prof. K. Rajaiah Prof. K. S. R. K. Prasad Dr. S. C. Lakkad Dr. S. Suryanarayanan Dr. A. C. Garg Shri N. K. Naik
3.	Propulsion	Prof. B. S. Chittawadgi Dr. S. K. Sane Dr. W. V. Nabar
4.	Transport Phenomena	Prof. G. S. R. Narasimhamurthy Prof. M. Raja Rao Dr. V. C. Rane Shri M. C. Dwivedi Dr. S. P. Mahajan Dr. S. L. Narayanamurthy
5.	Fuels, Lubricants and Petroleum speciality Products	Prof. S. Sarkar Prof. P. D. Sunavala Shri M. C. Dwivedi Dr. S. R. Patwardhan
6.	Surface and Ground Water Management	Prof. J. T. Panikar Prof. S. Narasimhan Prof. S. H. Nagaraj Dr. C. Natrajan Dr. J. S. R. Murthy Dr. B. Vasudeva Rao Dr. S. G. Joshi
7.	Thermodynamics of Vapours & Liquids	Prof. A. P. Kudchadker Dr. (Mrs.) M. Mukhopadhyay Dr. T. S. Raghunathan Dr. S. N. Vyas
8.	Catalytic Reaction Engineering & Process Development	Prof. S. Z. Hussain Prof. S. Sarkar Prof. S. K. Raman Prof. G. Mandal Prof. K. A. Naik Dr. B. K. Sadanda Rao Dr. S. Basu Dr. M. K. Trivedi Dr. T. S. Raghunathan Dr. C. K. Mittal Dr. V. G. Gurjar Dr. H. S. Shankar Shri M. P. Bhuskute Prof. G. Venkataraman Dr. K. P. Madhavan

S. No.	Area	Faculty Members
9.	Soil Engineering—(a) Expensive Soil Engineering (b) Deep Foundations	Prof. R. K. Katti Prof. B. S. Khadilkar Prof. K. R. Kulkarni Dr. V. S. Chandrasekharan
10.	Numerical Analysis of Structural Systems	Prof. C. K. Ramesh Prof. R. S. Ayyar Prof. D. N. Buragobain Dr. M. Kajani Dr. C. S. Gurujee Dr. R. M. Belkune
11.	Integrated Circuits and Devices	Prof. S. Mahapatra Prof. G. K. Bhagawat Dr. S. R. Jawalekar Dr. V. P. Sundersingh Shri J. Ramakrishna Shri S. K. Jain
12.	Switchgear, Design, Solid State Relays and Power System studies	Prof. S. K. Banerjee Prof. M. V. Hariharan Prof. M. D. Parmar Prof. R. Chatterjee Dr. B. N. Karekar Dr. M. S. Aggarwal Dr. T. K. Basu Shri S. A. Khaparde
13.	Communication Systems	Prof. B. V. Rao Shri M. Murugesan Dr. S. C. Sahasrabudhe Shri R. B. Joshi Shri J. Ramakrishnan Shri S. K. Jain Dr. R. Balasubramanian
14.	Solid Power Control	Prof. G. N. Revankar Prof. R. E. Bedford Prof. V. V. Athani Dr. S. K. Pillai Dr. G. C. De Dr. G. K. Dubey
15.	Machining Science and Machine Control tools	Prof. S. Somasundaram Prof. V. V. Athani Prof. M. M. Kulkarni
16.	Fluidics and Fluid Power Engineering	Prof. S. Kar Dr. B. D. Vyas Dr. (Mrs.) U. Powle
17.	Heat Transfer	Prof. S. P. Sukhatme Dr. A. W. Date Dr. G. K. Sharma Dr. B. S. Jagdish Dr. M. Achuthan
18.	Cryogenics	Prof. S. P. Sukhatme Prof. N. G. Narayanakhedkar Dr. G. K. Sharma Dr. S. G. Kandlikar
19.	Powder Metallurgy	Prof. G. S. Tendolkar Prof. P. Ramakrishnan Dr. T. R. R. Mohan Dr. B. K. Aggarwal

S. No.	Area	Faculty Members
20.	Phase Transformations	Prof. A. K. Mallik Prof. S. Bannerjee Dr. S.D. Kulkarni Dr. A. M. Rao
21.	Electro and Hydro-Metallurgy	Prof. R. Mallikarjunan Prof. D. L. Roy Prof. K. M. Pai Dr. S. Venkatachalam Dr. R. D. Angal Shri S. C. Dixist
22.	Thermodynamics and Polymer Chemistry	Prof. D. D. Deshpande Dr. M. V. Pandya Dr. G. N. Babu
23.	Electro Chemistry and Physical Chemistry	Prof. Hira Lal Prof. H. N. Shrivastava Prof. M. Sharon Dr. B. G. Bhat Dr. R. S. Singh Dr. R. Srinivasan
24.	Chemistry and Physics of Solid State	Prof. A. B. Biswas Dr. D. K. Chakrabarty Dr. H. V. Keer
25.	Organic Chemistry—Natural Products and Synthesis	Prof. A. M. Mehta Prof. G. D. Shah Prof. H. H. Mathur Dr. P. R. Iyer Dr. B. K. Sabata Dr. A. M. Saligram Dr. G. K. Trivedi Dr. S. S. Talwar Dr. A. K. Lala
26.	Applied Mathematics	Prof. R. D. Bhargava Prof. M. P. Rangarao Dr. B. S. Ramachandra Rao Dr. V. M. Soundalgekar Dr. M. G. Palekar Dr. R. L. Batra Dr. P. Chaturani Dr. S. P. Bhattacharyya Dr. V. P. Tyagi Dr. M. L. Mittal Dr. K. S. Panihar Dr. J. Prakash Dr. S. Santhanam Dr. M. N. Mathur.
27.	Statistics and Operational Research	Prof. N. M. Vartak Prof. C. R. Marathe Dr. M. N. Gopalan
28.	Numerical Analysis	Prof. P. C. Jain Prof. R. D. Bhargava Dr. Prem Narain Dr. M. G. Palekar
29.	Magnetism and Magnetic Materials	Prof. C. M. Srivastava Dr. C. Srinivasan Dr. S. N. Shringe Dr. P. J. Patni Mr. Om Prakash Dr. (Mrs.) P. Mukhopadhyay

S. No.	Area	Faculty Members
30.	Nuclear Physics and Elementary Particles	Prof. P.P. Kane Dr. A. S. Mahajan Dr. S. M. Bharathi Dr. G. Basavaraju Dr. V. L. Narsimhan Dr. Y. K. Gambhir Prof. S. H. Patil Prof. G. V. Das Dr. G. Bhattacharyya
31.	Optical, Magnetic Resonance and X-ray Spectroscopy	Prof. B. N. Bhattacharyya Prof. G. Thyagarajan Prof. B. D. Pandalia Dr. Deb Kumar Ghosh Dr. K. V. Lingam Dr. V. G. Viladkar Dr. R. Rajan Dr. M. J. Rao
32.	Theoretical Molecular and Solid State Physics	Prof. R. P. Singh Dr. J. S. Murthy Dr. D. K. Ghosh Dr. C. R. Sharma Dr. G. Mukhopadya
33.	Analytical and Coordination Chemistry	Prof. R. N. Mukherjee Prof. S. M. Khopkar Prof. T. S. Srivastava Dr. H. D. Bhargava Dr. M. C. Eshwar Dr. C. Chatterjee
34.	Industrial Design Centre	Prof. S. Nadkarni Mr. A. G. Rao Mr. U. A. Athwankar Mr. K. Munshi Mr. Kirti Trivedi

Indian Institute of Technology : Kharagpur (Estd: 1950)

S. No.	Area	Faculty Members
1.	Electromagnetics & Antenna	Prof. G. S. Sanyal Prof. B. N. Das Prof. B. K. Sarup Prof. M. Singh Dr. D. Bhattacharya Dr. H. M. Girija Dr. A. K. Mallick Shri V. M. Pandharipande Shri J. S. Rao Shri D. Dutta Shri S. N. Srivastava Shri B. Sen Shri M. Deshpande Dr. A. K. Bhattacharya
2.	Digital Communication System	Prof. J. Das Prof. M. N. Faruqui Prof. V. U. Reddy Dr. S. L. Maskara Dr. S. R. Rakshit Dr. C. V. Chakraborty Shri T. S. Lamba
3.	Structural Engineering	Prof. S. K. Mallick Prof. S. K. Niyogi Prof. A. P. Gupta Dr. C. S. Reddy Dr. S. S. Dey Dr. S. Mazumader
4.	Soil Mechanics and Foundation Engineering	Prof. D. P. Ray Prof. A. N. R. Char Prof. P. V. Narayana Dr. P. J. Pise Dr. B. Misra Shri P. Chatterjee Shri D. P. Ghosh Dr. C. S. Rao Dr. S. P. Dasgupta
5.	Corrosion Science & Technology	Prof. S. C. Sircar Dr. S. K. Bose Dr. S. K. Roy Dr. U. K. Chatterjee Dr. Sanat Roy
6.	Water Resources Engineering	Prof. B. N. Neogy Prof. S. N. Gosh Dr. B. S. Rama Rao Shri S. C. Sastry Dr. C. R. S. Pillai Shri M. N. Rao Shri G. L. N. Sastry Dr. S. K. Kar Dr. M. Mazumdar
7.	X-Ray & Structure of Matter	Prof. G. B. Mitra Dr. S. Bhattacharjee Dr. N. K. Mishra Dr. G. D. Nigam Dr. B. K. Samanta Roy Dr. B. K. Mathur

S. No.	Area	Faculty Members
8.	Ferrous Extractive Metallurgy	Prof. P. K. Sen Dr. D. N. Ghosh Dr. S. B. Sarkar Dr. A. Mukherjee Shri U.N. Mishra
9.	Applications of Earth Sciences to resource exploration and management	Prof. T. C. Bagchi Prof. D. K. Ganguli Prof. I.K. Kaul Prof. A. Mookherjee Prof. D. Niyogi Prof. S.V.L.N. Rao Dr. T. K. Bhattacharyya Dr. A. Chakraborty Dr. H. C. Das Gupta Dr. H. P. Patra Shri S. H. Rao Dr. K.K. Roy Dr. D. K. Sen Gupta Dr. A. K. Bhattacharyya Dr. S. Sen Gupta
10.	Crustal Evolution	Shri K. Naha Dr. S. K. Sen Dr. D. S. Bhattacharyya Dr. A. K. Chaudhuri Dr. B. K. Ghosh Dr. A. B. Mukherjee Dr. C. N. Rao Shri D. Dasgupta Dr. A. K. Guha Dr. D. P. Sen
11.	Fluidisation Engineering	Prof. P. Sen Gupta Dr. V. Mahadevan Dr. H. R. Takhlate Dr. U. P. Ganguly Dr. D.D. Kar Shri S. K. Sawarkar
12.	Multiphase Dispersion	Prof. D. K. Guha Prof. A. K. Mitra Prof. N. K. Roy Prof. T. S. Banerjee Dr. B. C. Bhattacharyya Dr. R. N. Ghar Dr. M. N. Biswas Dr. D. K. Acharjee Dr. H. R. Takhlate
13.	Ejectors & Jet Reactors	Prof. A. K. Mitra Dr. M.N. Biswas Dr. D. K. Acharjee Prof. N. K. Purohit Shri V. R. Radhakrishn Shri D. Mukherjee
14.	Mineral Engineering	Prof. P. Sen Prof. P. Sengupta Prof. H. R. Takhlate Shri D.D. Misra Dr. D.D. Kar

ANNEXURE X

Quantum of foreign aid/technical assistance received by institutions other than IITs till 1-1-1979

Sl. No.	Institution	Scheme	Equipment Rs. in lakhs	Guest faculty from abroad Man-months	Indian faculty training abroad Man-months
1	2	3	4	5	6
1.	Baroda University . .	Indo-USSR Agreement	4.66	54	36
2.	IIM, Ahmedabad . .	Ford Foundation	39.51	36	36
3.	NITIE, Bombay . .	ILO/UNDP Scheme	1.18		99
4.	TTTI, Chandigarh . .	Indo-Netherland Government Agreement	12.86	240	90
5.	TTTI, Bhopal . .	Colombo Plan	13.55	180	120
6.	Maulana Azad Regional College, Bhopal	UNDP Programme	47.15	162	185
7.	Motilal Nehru Regional Engg. College, Allahabad	UNESCO AID 12 Million Dollar	15.50 1.10	245 —	84 —
8.	BHU-IT, Varanasi . .	12 Million Dollar	4.25	80	35
9.	TTTI, Madras . .	Commonwealth Education Programme and Colombo Plan	6.87	327	69
10.	NIFFT, Ranchi . .	UNDP-UNESCO Aid	$ 3.64 lakhs	214	71
11.	Regional Engineering College, Durgapur	US 12 Million Dollar Programme	$ 4.42 lakhs	146	132
12.	Regional Engineering College, Surathkal	UNESCO Aid	$ 3.11 lakhs	85	163
13.	Regional Engineering College, Warrangal	UNESCO Aid	$ 5.14 lakhs	426	332
14.	Visvesaraya Regional Engineering College, Nagpur	UNDP Programme	$ 4.26 lakhs	65	89
15.	Regional Engineering College, Tiruchirapalli	UNDP Assistance	$ 1.14 lakhs	48	—
16.	Regional Engineering College, Rourkela	UNDP Assistance	Rs. 14.00 lakhs	24	45
17.	IIM, Calcutta	Ford Foundation	$ 26.92 lakhs	504	195
		Total	Rs. 161.00 lakhs and $ 49.00 lakhs	2836	1781

List of imported equipment lying idle due to lack of spares

I INDIAN INSTITUTE OF TECHNOLOGY : DELHI

S. No.	Name of the equipment
	Electrical Engineering Department
1.	D.C. Serve System Type ESIB.
2.	Resolved Component Indicator Model VP 250-2 Solartron.
3.	Wave Analysor TF 2330 (Marconi) (215 W3).
4.	FM/AM Signal Generator TF 995A/2M (Marconi) (75924).
5.	Standard Signal Generator TF 144H (Marconi) (76925).
6.	Q Meter Type T2 (Advance) (134Q1).
7.	Wide Range R. C. Oscillator Type TF 1370 (Marconi) (67916).
8.	Double Pulse Generator TF-1400 /3 (Marconi) (225933).
9.	Oscilloscope Cossor CDU 110.
10.	Sweep Generator (324943).
11.	C.R.O. Advance OS 25B (309-0-24).
12.	Pulse Generator Solortion Type (81930).
13.	Communication Receiver Model 770 R.
14.	Communication Receiver Model 830 (27C1).
15.	Advance, Oscilloscope OS 25 B, 5 MHZ.
16.	Telequipment 83 Double biam Oscilloscope.
17.	Opamp Module for EAL 580 Hybrid Computer.
18.	Amplifier Magnetic Educational Type 08/1 Sl. No. R 33836 & R.33833 (2 Units).
19.	Power Supply Transistor Type 2402 A.E.I.S. No. 265 & 267 (2 Units).
	Chemistry Department
1.	X-ray unit Model R X 3.
	Physics Department
1.	Micro-Densitometer
2.	Lindman Electrometer
	Mathematics Department
1.	Aroor in brief photo-copying machine.
	Civil Engineering Department
1.	Direct writing oscillograph recorder.
2.	Digital voltmeter.
3.	PP60 V.A.P. Amplifier.
4.	PP 250 VAP Amplifier.
5.	Avometer.
6.	Elecomatic 4 Channel Pen Recorder.
7.	100 Wat Amplifier.
8.	Ultrasonic Material Tester.
9.	ALLAM Poker Vibrator.
10.	Computerised Datalogger..
11.	2000 psi, lateral pressure maintaining set up 1973.
12.	Self compensating mercury pot pressure control system.
13.	EVT Viscometer.
14.	Standard Penetro-meter.
15.	Twin Composite Visco-meter.
16.	Instron Model 1195 Universal Testing Machine.
17.	Dissolved Oxygen meter 15A, SN 15782A.
18.	Potentiometer Recorder Servoscribe Model P 120.
19.	PH Meter (Direct reading) Model 23A.
20.	PH Meter Model 7035 (EIL).

S. No.	Name of the equipment
21.	Flow meter Lab. Kit (FL 600m).
22.	Magnetic Stirrer.
23.	Candy filter.
24.	I*microphtic theodolite, watts, No. 2 (ST 200)*.
25.	Tavistock Theodolite MK II*.
26.	IBM Electric Typewriter 835 Length 15.5 in.
	Centre for Biochemical Engineering
1.	Polarograph (Combride pen recording).
2.	Low temperature cabinate model T 300.
	Computer Centre
1.	ICL 1909 Computer System.

II INDIAN INSTITUTE OF TECHNOLOGY: MADRAS

	Computer Centre	
1.	IBM 1403-NI Printer (2 Nos.)	
	Applied Mechanics	
1.	Universal Impedence Bridge UB-70	
2.	Soemtron Calculator 214.	
3.	Absorption wave meter AWM 623.	
4.	Regulator power supply PS 46.	
	Electrical Engineering	
1.	Manganin wire insulated (Enamelled/D.R.C.) Different sizes of 46, 40, 32, 30, 26, 20, and 14 SWG	1 kg each
2.	Vaccum tubes: EL 84, ECC 83, ECC 82 — 30 Nos. each	
3.	Diodes : By 127/126 — 50 Nos.; EC 103 — 25 Nos.	
4.	Capacitors : 1 uF/450 V — 25 Nos.; 0.5 uF/450V — 25 Nos.	
5.	Resistors (High Values viz. 1 M. ohm, 3.0 M. ohm, 5.6 M. ohm and 8.2 M. ohm and 10 M. ohm	20 Nos. each
6.	Precision potentiometers (Various Values).	

III INDIAN INSTITUTE OF TECHNOLOGY: BOMBAY

	Department of Physics	
1.	Helium leak detectors	4 Nos.
2.	Liquid N_2 containing 5 lit capacity	1 No.
3.	PH meter	1 No.
4.	Arc generator	1 No.
5.	Arc-spark generator	1 No.
6.	X-ray power supply	1 No.
7.	Spectrum projector	1 No.
8.	Double beam spectro-photometer (visible)	1 No.
9.	Ballistic galvanometers	4 Nos.
10.	Microphotometer (nonrecording)	1 No.
11.	X-ray diffraction unit	2 Nos.
12.	Colorimeters	2 Nos.
13.	Steelscope	1 No.
	Department of Mechanical Engineering	
1.	Electric furnace (IIT. MWM 49) Type OKE-210T, saratove works phase 3, KW 50, temperature 1300°-C.	1 No.
2.	Ammonia refrigeration plant complete with compressor, condenser evaporator and controls	1 No.
	Department of Aeronautical Engineering	
1.	Power backsaw M/c with 1 HP motor complete with starter, pully, gofan	1 No.
2.	B.M.T. Thickness Planning Machine	1 No.
3.	Ashok Indian Make Wood turning Lathe M/c.	1 No.
4.	Hero's brand model No. 6-ISSCCU bed motorised lathe M/c.	1 No.
5.	Surface grinder USSR make Cap. 630	1 No.

IV INDIAN INSTITUTE OF TECHNOLOGY: KHARAGPUR

S. No.	Name of the equipment	
	Department of Chemical Engineering	
1.	Lavibond Tintometer	
2.	Gasoline Gum Content apparatus	
3.	Cenco-Shear Sanford Photolemeter, Type B-2, (Cholorimeter)	
	Department of Mechanical Engineering	
1.	Merchant Calculating machine Model 8 EFA (Ref.)	1 No.
2.	Electric hand drill Model CH. 9.153 (Ref.)	1 No.
3.	In Mount Oscillograph Type 401A (MDY)	1 No.
4.	G.R. Vibration Meter Type 761-A (MDY)	1 No.
5.	G. R. Vibration Analyser Type 762-B (MDY)	1 No.
6.	Kelvin & Hugles Pen Recorder Type 11A (MDT)	1 No.
7.	Multimeter Sakura (MDY)	1 No.
8.	Multimeter 300 BTA (Sanwa) (MDY)	1 No.
9.	Ricardo variable compression engine is in working condition but not running efficiently for want of spares. Engine can be run with condemned gasket but there will be leakage of some gases. (ICE).	1 No.
10.	Lindberg Combustion Furnace & Carbon Determinator. (FE)	
11.	Kjeldall digestion apparatus (FE)	1 No.
	Department of Electronics & E.C.E.	
1.	CISS 1B Oscilloscope	1 No.
2.	Heathkit Oscillator AO-1	1 No.
3.	VTVM Heathkit AV-7	1 No.
4.	AEC VTVM	1 No.
5.	VTVM CISS Made	1 No.
6.	Allied Electronics VTVM	1 No.
7.	Power supply of magnet model CCP-100	1 No.
8.	Received super skyrider Model SX-28	1 No.
9.	Audio Oscillator Phillips GM2307, NRD 2676	1 No.
10.	Test Oscillator TS 471APR	1 No.
11.	Signal generator I-98-A, Sl. No. 398 Philco Corpn.	1 No.
12.	Signal Generator I-98-A, Sl. Nos. 2540 and 2538	2 Nos.
13.	S.R. Oscilloscope Philips GM 5654	1 No.
14.	Radar Set AN/TPS/2.	1 No.
15.	Transmitter T-25/TPS/2.	1 No.
16.	Radio DF Eqpt. ECE/TR/13, Type CIA-46174, Sl. No. 297.	1 No.
17.	Test Set TS-100/AP, Sl. No. 3940	1 No.
18.	Radar Eqpt. RC-246-A. Oscillator Unit, BC1096 A part of SCR 584	1 No.
19.	AF Oscillator Heathkit, MK-II, Model AG18	1 No.
20.	RF Oscillator Heathkit, AG-1.	1 No.
21.	GR VTVM Model 1803B, Sl. No. 776 & 768	2 Nos.
22.	AC Milliveltmeter WG (level meter)	2 Nos.
23.	WG NAG-17 Power supply	3 Nos.
24.	Precise Oscilloscope	1 No.
25.	Receiver BC779A, Sl. No. 2321 & 5759	2 Nos.
26.	Avo valve characteristic meter AVO-3, No. 174	1 No.
27.	Video Oscillator TF8864/1, Sl. No. 1949152	1 No.
28.	QMG3 WG Audio Oscillator, Sl. No. 107	1 No.
	Department of Geology & Geophysics	
1.	Seismic Unit of 12 refraction and 12 reflection channels	
2.	Worden Gravimeter	
	Department of Electrical Engineering	
1.	Ferm ferrodynamic recorder	1 No.
2.	Vibration Galv. meter (Cambridge).	2 Nos.
3.	Pye & Co Ballastic Galv. meter	1 No.

Note : The IIT, Kanpur has not submitted the list of equipment lying idle due to lack of spares.

List of obsolete equipment in working condition

I INDIAN INSTITUTE OF TECHNOLOGY: DELHI

Sl. No.	Name of the equipment	No. of units available
	Department of Electrical Engineering	
1.	Amplifier for Recorder Quick Resoponse type PA 10 MG2 S. No. 1715822	One
2.	Recorder Amplifier Quick response type QW/CR53 & type AU/CRDIO S. No. 1618641 & 164072	Two
3.	Analog Computer Group type TR 20R Model No. 1020 Q 23 S. No. 115.	One
4.	Oscilloscope Solartron type AD 557 S. No. 91976	One
5.	Oscilloscope Solartron Type CD 1183 S. No. 118668, 118472 & 106216	Three
6.	Oscilloscope Solartron CD 1400 S. No. 201562	One
7.	Double Beam Oscilloscope D. 31 Telequipment DC-5 MHZ, 100 mv	Two
8.	Simpson Oscilloscope Single Beam 458-1 5 MHZ. 100 mv.	Three
9.	AF Amplifier & Null Detector (Radar)	One
	Department of Textile Technology	
1.	Pirn winder "Lessons No. 90"	One
2.	Loom 36" Butterworth terry	One
3.	Loom 36" Butterworth Circular loom	One
4.	Loom 38" Toyda automatic	One
5.	Loom 36" Nogamy automatic	One
6.	Drawing Frame Platts	One
7.	Intermediate frame 'Platts'	One
8.	Cone and Chese winding	One
9.	Silver lap machine	One
10.	Ring spinning warp frame	One
11.	Ring spinning waft frame	One
12.	Comber Nasmoth	One
13.	Ribbon lap machine	One
14.	Slabbing frame	One
15.	Loom under pick 44"	One
16.	Loom Plain 36" Texmaco	One
17.	Loom 36" Cooper	One
18.	Loom 56" Cooper	One
19.	Dobby (Richardson) 16 shafts	One
20.	Dobby Kirloskar 40 shafts	One
21.	Jacquard double lift double cylinder 400 Hools, "Hardakar"	One
22.	Drum winding machine (Second hand)	One
23.	High speed warping machine with creel	One
24.	Under motion	Two
25.	Handloom 20" DB	Five
26.	Handloom 20"	Six
27.	Dobby Handloom "Hardakar"	Five
28.	Jacquard Handloom 200 Hooks "Deepak"	Five
	Department of Physics	
1.	X-ray Unit with Camera	One
2.	SP-500 Spectrophotometer	Two
	Centre for Bio-Medical Engineering	
1.	DCM Make Calculator Model No. MOSCAL 1400 Sl. No. 50910	One

Sl. No.	Name of the equipment	No. of units available
	IDD Centre	
1.	Oscilloscope Simpson Model 411-1 S. No. 20560 and 20731	Two
2.	Tester I.C. Digital Model 201 B	Three
3.	Multimeter Simpson make model 260-6M with leather case	Three
4.	Multimeter (Simpson Make) model 269-1 with leather case.	Three
5.	Ammeter AC Type Simpson Adopter 653 Type	Three
6.	Microvolt Attenuator Type 655 Simpson Adopter	Two
7.	Audio Wattmeter Type 654 Simpson Adopter	One
8.	Milliohm Meter Type 657 Simpson Adopter	Two
9.	VTVM Type 651—Simpson Adopter	One
10.	Temperature Tester Type 652 Simpson Adopter	Two
11.	Soldering Gun 65 watt	Three
12.	Stand Assembly	Six
	Biochemical Engineering Research Centre	
1.	Air Flow Recorder Model : Code No. KHD/G.H	One
2.	Honeywell Temperature Model No. Y 15201215-01-01-2-093-024-00-018-144	One
3.	PH probe Industrial type VA 732N.	One
	Central Workshop	
1.	Lathe Machine	Eight
2.	Lathe Machine	Five
3.	Lathe Machine Harihar MK-D2-226 228	Four
4.	Sharping Machine 223 230	Two
5.	Capstan Lathe Model AMT-120	One
6.	Power Hammer	One
7.	Sand Mullar	One

II INDIAN INSTITUTE OF TECHNOLOGY : MADRAS

	Computer Centre	
1.	IBM 082, Model i Sorter	One
2.	IBM 056, Model ii verifiers	One
3.	IBM 059, Model ii Verifiers	Two
4.	1 No. IBM 024, Model i and 1 No. IBM 024, Model ii Key punches	Two
	Mechanical Engineering	
1.	Deutz Gas Plant, Gas Engine and pump	One
2.	Borgward 4-cylinder petrol engine	One
3.	ILO two-stroke diesel engine	One
4.	Carrier Frequency Amplifier Make: Hottinger Baldwin Masstechnik, Type: KWS/6T/5	One
5.	Oscillophil: Make : Siements, Type SIT-1°6/250D	One
6.	Horizontal Boring and Milling machine Make: Scharmann, Type : WB 75	One
7.	Three dimensional dynamometer: Make: Hellmut Fischer GmbH, Type SF1	One
	Applied Mechanics	
1.	A.F. generator GM 2308/90 Philips	One
2.	Volt. Ohm-meter GM 6009/90 Philips	One
3.	Q-Meter QM-46	One
4.	Electronic Stimulator 904 A Radart	One
5.	Oscilloscope GM 5655/90	One
6.	LVDT Transducer TD10 NAL Amplifier Type 200/100	One
7.	Crystal Calibrator 901A Radart	One
8.	Distortion factor meta 610A	One
9.	Potentiometeric stripchart Recorder RFT	One
10.	Calculator Cellabson R43 SM	One
11.	Coil Winding Machine 'Technomex'	One

Sl. No.	Name of the equipment	No. of units available
	Metallurgy	
1.	Hacksaw Machine —1 No. (German)	One
2.	Air Compressor (Indian Make) —1 No. (Indian)	One
3.	Oil Fired Furnace —1 No. (German)	One
4.	Sand Testing Machine —1 No. (German)	One
5.	Permeability meter —1 No. (German)	One
	Electrical Engineering	
1.	Marconi VTVM	One
2.	Wandel and Goltermann VTVN	Five
3.	Heathkit VTVM	Two
4.	Siemens Oscilloscope 5 MHZ	Two
5.	Simpson Oscilloscope Type 466	Two
6.	Resistance boxes	Six
7.	Taylor Signal Generators	One
8.	Wandel and Goltermann Regulater Powei Supplies	Two
9.	Voltmeters (M.I. Type)	Three
10.	Voltmeters (M.C. Type)	Two
11.	Ammeters (M.I. Type)	Seven
12.	Suspension Mirror Galvanometers	Six
13.	Wattmeters UPF /LPF	Five
14.	Volt ratio box	Two
15.	Rheostat	Four
16.	Single-phase/3 phase Variact	Five
17.	Vacuum Tube Voltmeters	Two
18.	Multimeters	Six
19.	Laboratory grade Direct Reading Potentiometer with accessories	Two
20.	Stop Watch.	Two

III INDIAN INSTITUTE OF TECHNOLOGY: BOMBAY

Department of Chemistry

1. Shaker (Gansions Limited) Sr. No. 305.

Department of Mettalurgical Engineering

1. Semi-microbalance type B1
2. Analytical Balance
3. 16 Ton Automatic Cam Press for hard carbide powders
4. Vibratory Mill
5. Bottle Mixer with sockets and motor
6. Semi Microbalance
7. Rockwell Hardness Tester
8. Mounting Press
9. Microscope
10. Potentiometer 'Bajaj' Portable
11. Potentiometer USSR
12. Hacksaw Machine, Heavy Duty
13. Lathe MMC 174N, 1.5 HP
14. 3 pH Transformer 127V
15. Micro Balance without weight
16. Hand shearing machine
17. Humidifier with hygrometer
18. Dual Beam Oscillograph
19. 2 Pan Balance
20. Single pan Balance

Sl. No.	Name of equipment	No. of units available
	Department of Mechanical Engineering	
1.	Automobile (6) cylinder petrol engine 70 H.P. at 2800 rmp	
2.	Marine diesel engine 140 H.P.	
3.	KODAK Document copying prints, Model No. 10/14	
4.	KODAK Document slate	
5.	KODAK Screen	
	Department of Aeronautical Engineering	
1.	Electrically operated fully automatic merchant calculator	
2.	'Soentron' Electric Desk Calculator	
3.	Facit Calculator	
4.	Strain Measuring equipment MSI 88	
5.	Strain Measuring bridge	
6.	32 point strain measuring equipment	
7.	Dynamic balancing machine EL 30 No. 656	
	Department of Electrical Engineering	
1.	Mass Spectrometer Russian Make Mu-1305 Serial No. CTY 79-156-62 Manufactured in 1965 (approximate) Located in Room A-2 (E.E. Dept)	
2.	Vacuum-cum-Pressure Impregnating plant	
3.	Hydrogen Atmosphere Pusher Electric Furnace	
	IV INDIAN INSTITUTE OF TECHNOLOGY : KHARAGPUR	
	Mechanical Engineering Department	
1.	National Gas Engine (GD)	One
2.	Victor Computing M/c	One
3.	Gum Apparatus	One
4.	Spectrometer	One
5.	Bunkers (bunsen etc.)	One
6.	Rotameters	One
	Electronics & ECE Department	
1.	AC/DC VTVM (GR) Type 1800A Sl. No. 3979	One
2.	AC/DC BTVM (GR) Type 1805B Sl. No. 768	One
3.	AC/DC BTBM (GR) Type 1803B Sl. No. 766	One
4.	AC BTBM WG Type TBM23 Sl. No. 006	One
5.	AG BTBM WG Type TBM23 Sl. No. 005	One
6.	Milivac voltmeter	One
7.	Precise Oscilloscope B-5050	One
8.	Tube tester Hickok	One
9.	CRO CISS Model B-1	One
10.	CRO Philips, Model 5633, No. 1121	One
11.	Oscilloscope TS34A	Two
12.	Travelling wave tube amplifier HP 490B	One
13.	Radio receiver BC1066B, SR 2645, Philco Corpn.	One
14.	Milivac meter	One
15.	CISS Model IB, Oscilloscope	Two
16.	Signal Generator AVO	One
17.	WG Wandel KGM-1 Audio Oscillator, Sl. No. 015.	One
18.	TWT Amplifier tube Hugginsha HA4B	One
	Physics & Meteorology Department	
1.	Voltage Stabilizer (Magnetic)	One
2.	Vibrating Reed Electrometer	One
3.	Oscilloscope Philips	Two
4.	Signal Shift Meissner (Deluxe)	One
5.	Signal generator E200	One
6.	Oscillograph double beam Cossor.	One

S. No.	Name of equipment	No. of Units available
7.	60 264 Recorder Unit (RD-6/ANQ-2)	One
8.	X-ray Field Unit (Picker's)	One
9.	Philips Cathode ray oscilloscope No. GM 3156	One
10.	Radart oscilloscopes	Two
	Geology & Geophysics Department	
1.	Resistivity Meter (Manufactured by ABEM, Sweden)	Six
	Metallurgical Engineering Department	
1.	X-ray Diffraction Apparatus, ISO-Debyeflex.	
2.	Seifert's X-ray tube for Crystallography.	
3.	Universal Tensile Testing Machine Sl. No. 408.	
4.	Okay Electric Salt Bath Furnace.	
5.	High Temp. Furnace (Tammann).	
6.	Metallurgical Microscope.	
7.	Leitz Panphot Mettallographic Microscope	
8.	Standard Metallurgical Microscope.	
9.	75 KV Electron Microscope.	
10.	EM-6 Electron Microscope.	
11.	High Frequency Converter.	
12.	Several Heat-treatment furnaces.	

ANNEXURE XIII

List of emerging areas of national relevance

Sl. No.	Area	Field of interest/relevance	Plan programmes related to sector/ Deptt./User
1	2	3	4
1.	Agronomy . . .	Efficiency of conversion of cultural energy into food energy; crop weather watch; Rhizobium cultures for leguminous crops; early bearing dwarf varieties of mango.	Agriculture Research
		Crop weather relationship.	Indian Meteorological Deptt.
2.	Plant Genetics . .	Genetic wealth conservation in major economic plants; Germ plasm materials development for wheat, maize, millets, sorghum; Germ plasm base for development of commercial crop e.g. cotton; Mobilisation of genetic resources for jute and allied fibres e.g. rami, sisal etc.; Germ plasm development of sugarbeet.	Agriculture Research
3.	Plant Pathology . .	Rust and foliar disease resistance in wheat crop; disease resistant sugarcane seedlings; seed borne disease.	Agriculture Research
4.	Agricultural Engineering	Appropriate machinery development for dryland agriculture; energy requirement for intensive agricultural production.	Agriculture Research
5.	General Agricultural Research	Integrated farm products utilisation; Recycling of rural wastes.	Agriculture Research
6.	Soil Mechanics & Soil Research	Nutrient movement and transformation in different soils moisture stress in rainfed rice crop;	Agriculture Research
		Models in soil mechanics; soil stabilisation; physical behaviour of rock masses; grouting techniques; engineering characteristics of marine soil;	Irrigation
		Static & dynamic soil structure & interaction; soil data & soil map in offshore areas' soil/pipeline interaction; Thermal behaviour of rocks (high termperature & high pressure).	Petroleum
7.	Animal Husbandry .	Semen biochemistry, sperm morphology and semen preservation techniques for livestock.	Agriculture Research
8.	Fisheries . . .	Genetic improvement in culturable fish species; Fish processing industry.	Agriculture Research
		Sea Water irriculture.	CSIR
9.	Forestry . . .	Introduction of important exotic species/tree species; Rehabilitation of degraded forests; Afforestation of special site; Environmental conservation; ecological studies in Indian forests; physiological & biochemical studies on growth development and regeneration of forests tree species; survey of insects, pests and their control Farm forestry and range management; Chemical utilisation of wood; Hard Board, Particle board and composites from wood; Identification of lesser known species of timber; Grading of hard wood for paper & pulp industry; Minor forests products survey & utilisation.	Forestry Research
		Watershed management, Water harvesting, Water budgetting studies; plant water soil relationship.	Forestry Research

1	2	3	4
10.	Irrigation Engineering .	Ponds & structures on watershed basis, Fluid mechanics; Experimental laws & techniques– simulation studies & models; long term behaviour of dams and their maintenance; Distress in hydraulic structure; computer aided design; Rationalization of river formulae; conjunctive use of surface and ground water.	Agriculture Research Irrigation
11.	Water Management .	Geohydrology; hydrology; hydro-meteorology; water distribution management; flood forecasting Reduction losses from reservoirs.	Irrigation
		Techniques for water balance studies.	Indian Meteorological Deptt
		Water managment in tea plantation.	CSIR
		Numerical methods for hydrological forecasting.	Irrigation CWC
		System hydrology, Parametric hydrology, stochastic hydrology; Hydrologic aspects of weather modification; Underground storage of surplus water, National water Budget; Optimum water utilisation in the long term and short term.	NIH
12.	Nutrition . . .	Protein caloric malnutrition; Long term effects of early malnutrition.	Health
13.	Immunology . .	Protective immune mechanisms in cholera; Immunology of Tuberculosis; sequential immunization; Immunological studies in Leprosy.	Health
14.	Fertility. . . .	Fertility regulating agents under nutritional, environmental and other indigenous health variables; Infant mortality and its correlate; reproductive disorders.	Health
15.	Virus Research . .	Arbo virus; cytology & cytogenetics studies; Highly infectious viruses; DNA recombinats.	Health
16.	Communicable Diseases .	Biological and environmental methods for vector control; Entero viruses as eytiological agents for disease.	Health
17.	Occupational Research .	Vaccines for anti amoebiasis Noise pollution; Energy balance studies in work situations; threshold limit values for industrial toxicants.	CSIR
18.	Advanced Biological Research	Tissue culture techniques; cloning for plantation crops;	Agriculture Research
		Radiation sensitisation & photosynthesis in crop plants	Atomic Energy
		Tissue culture; Molecular Biology; Marine algae; Microbial enzymes; Cellular & Molecular Biology; Tissue culture.	TIFR CSIR CSIR
19.	Power and Energy . .	Geothermal energy; Tidal energy; solar energy and Biogas;	Energy & DST
		Coronal & radio interference studies Hot line maintenance studies; Characteristics of bundle conductors; composite insulator.	Power
20.	Structural Engineering .	Offshore structure; Design of platforms; Fatigue behaviour of materials; Stress analysis of sub marine pipeline.	Petroleum
21.	Reservoir Engineering .	Laser technology for oil well stimulation. RF heating techniques for oil well bottom hole heating; Rheology of high viscous curde; Artificial lift technology; Fluid dynamics through porous media; Development of Mathematical coning techniques,	Petroleum
		Pipeline transportation of waxy crude.	CSIR
22.	Geosciences . . .	Biostrategraphy studies; Hydrocarbon migration & entrapment; Mathematical modelling in exploration geophysics; Modern well logging system; Palaconological & Palaeontological studies.	Petroleum

1	2	3	4
		Deep Seismic sounding Techniques.	CSIR
		Sedimentary basin analysis; Aerial thermal imagery; Induced polarization survey.	Coal
		Productivity norms in mines; Minerals waste utilisation; pre cambian geological investigation; Remote sensing application for mineral resources survey.	Mines
23	Ocean Science and Ocean Engineering	Wave spectra for coastal water Coastal engineering	Petroleum Irrigation
		Phytoplankton & Zooplankton from Indian Ocean; Biological resources in sea around India.	CSIR
		Marine Instrumentation systems.	CSIR
		Geophysical techniques; Magnetics gravity & deep/ shallow seismic, vibrocoring, Dredging, Shallow drilling, Palaeontology and sampling of marine sediments; Geochemistry of continental shelf sediments; geology of continental shelf structures and topography of ocean floor; Minerals deposits on continental shelf; Monsoon research Bay of Bengal cyclogenesis; Arabian sea studies; Coastal oceanographic parameters (for transportation system), Coastal reclamation and coastal erosion; Marine ecology and marine pollution problems.	OSTA
24.	Minerals & Mining Technology	Long wall face mining technology; Heat flow studies in coal mines; Workability indices of coal seams; Hydraulic mining; Water infusion in coal;	Coal
		Hydrogeological investigation for coal; shear wave seismic refraction survey Rock mechanics & mine support;	
		Techniques for recovery of minor and rare metals from flu dust; long hole rising over long lifts; Floatation studies of polymetallic ores; Incidence of Mica in pegmatite.	Mines
		Pre-heating and pipeline charging of coal.	Steel
25.	Chemical Engineering & Chemical Technology	Hydrofinishing; hydrocracking; cat cracking technology; trays for vapor liquid contract system; radiative heat transfer and burner development problems;	Petroleum
		Optimal system of recovery of fines; Chemical demineralisation of coal; Vapour phase extraction of coal; solid smokeless fuels.	Coal
		Formed coke technology; Agglomeration of ore fines, Conservation of water and recycling Miniaturisation of ammonia plant; Active carbon or other absorbant from vegetable wastes; High pressure hydro gassification of coal; Catalysts for hydrogen cracking; substitute for platinum; Indigenous hydro-refining and indigenous deoxo and pre reforming catalyst; Heat insulating material; Coal gassification,	Steel Chemical and Fertilizers
		Molecular sieves; Vapour phase oxidation of anthracine; Membrane Technology for caustic soda; Utilization of sulphur sludge; Alternative fuel for carbon black	Chemical and Fertilizers
		Nickle hydrogen battery and energy storage system; corrosion inhibitors; on exchangers; glass ceramics; Monolithics and super refractories; Non oxide refractories; Molecular sieves; Fluid couplings.	CSIR

1	2	3	4
26.	Metallurgy . . .	Cold bonded pelletization; coal dust injection technology; Direct reduction processes for steel; Electron slag refining techniques; Cold rolled grain oriented silicon steel; Process controlled computerisation in steel industry.	Steel
		Zone refining of metal (Electron beam); Pyrohydro and electro metallurgy of less common metal; Refractory system; Ultra pure materials (semiconductor areas).	Atomic Energy
		Electro metallurgy (electro forming, electro organic coating, metal electro organic finishing), Hydro electro metallurgy; Powder metallurgy Titanium alloys.	CSIR
27.	Meteorology . . .	Snow & glacier physics studies; Meteorological sensors; Biometeorology; Numerical weather prediction; Ozone radiation and atmospheric electricity; Statospheric and merospheric meteorology; Numerical models in monsoon research.	Indian Meteorological Deptt.
		Warm cloud electrification; Cloud seeding nuclei generator.	Indian Instt. of Tropical Meteorology
		Terrestrial atmospheric Chemistry.	Atomic Energy
		Space meteorology	Space
28.	Seismology . . .	Seismicity & Seismotechtonic studies; Earthquake prediction techniques.	Indian Meteorological Deptt.
29.	Climatology . .	Tidal wave & effects; Climate dynamics Rainfall climatology,	IMD
		Climate modelling; Dynamics of large scale monsoon system; Tropical cyclone prediction.	IITM
30.	Astrophysics/Astronomy/ Ionospheric Research.	High resolution astronomy and image processing techniques; Chromospheric phenomena studies and solar studies;	IIA
		Infrared astronomy; Cosmic ray; Aeronomy & astrophysics; All sky camera for meteorite.	Space
31.	Geomagnetism . .	Morphology studies related to geomagnetism; Magetospheric electric fields; Wave particles interaction in magnetosphere and solar wind.	IIG
32.	Environmental Research & Pollution Control	Air pollution abatement	IMD
		Pollution containment measures; Containment of liquid effluents.	Chemical & Fertilizers
		Pollution indicator in marine environment.	CSIR
		Environmental monitoring of gassy mines.	Coal
		Environment of rural & urban settlement; Resources management; Environmental degradation, Environmental Planning, training and education; Man & Biosphere: ecological effects of human activities on forests ecosystem; Land use practices; Aquatic systems; Impact of pest management, Mountain ecosystem & perception of environmental quality.	NCEPC
33.	Building & Construction Research.	Utilisation of agro industrial waste; Improvements of kilns and furnaces; Low cost housing design; Rural Housing; Industrial Buildings and other functional building design, Economic flooring and roofing system; Composites and synthetics for building material; Prefab technology	Works & Housing

1	2	3	4
34.	Electronics . . .	Automatic fire detection system	Coal
		Mircowave ferrites; Multilayer ceramic capacitors; Hybrid microcircuits and ICs; Computer-aided design; Microprocessor based multifunction instruments; Hybridization technology.	Electronics Commission
		Opto-electronics instrumentation; Specialised multi-channel analyser system; Photo electric imaging device; Microprocessors and Mini computers	Atomic Energy
		Data communication techniques; Advanced tracking system	Space
		Digital electronic data processing; Opto electronics instrumentation,	CSIR
		Solar energy–Thermal and photo voltaic techniques;	DST/CSIR
		Monolithics ICs; Microwave diodes; Microprocessors: Hypermeability ferrites; Ferro electric ceramics; Cermets and metal films; Electro luminiscent materials.	Electronics Commission
35.	Communication . .	Electronic exchanges; Microwave propagation studies; Under water TV system,	Electronics Commission
		Millimeter wave communication; Microwave remote sensing research; Maritime satellite communication system; Side looking air borne real aperture radar; Satellite VHF/UHF communication.	Space
		Tropospheric and Ionospheric communication; Tropocator studies.	CSIR
		Microwave Engineering.	TIFR
36.	Fibre Optics . . .	Optical fibres; Optical fibre communication system;	Electronics Commission
		Fibre Optics	TIFR
37.	Chemical and Intermediate.	Silicones for electronics industry Pure silicon, silicon wafer and silicon ribbon technology	Electronics Commission
		Pentaerythritol; Diphenylamine; Trimethylphosphite; Copper sulphate from sulphide ore; Polyphosphates; Methylchlorosilanes, Synthetic polyelectrolytes; Microfine alumina; Industrial enzymes; Plant growth regulator; Pyridine bases from aldehydes and ammonia; Electrochemical preparation of organic fine chemicals; Anti-bacterial compounds from sea weeds; Polysulphide resins; Dimer acids; Diepoxy resin; New development of metallic anodes.	Chemical and Fertilizers
		Alcohol/Mollasses based chemicals	CSIR
		Carbon fibres	DST
38.	Fertilizers . . .	Biological nitrogen fixation;	Agriculture Research
		Biofixation of nitrogen; Controlled release fertilizers.	Chemical and Fertilizers
39.	Physics/Applied Physics including Nuclear Physics etc.	Biological crystallography; Ferro elasticity; Computational Physics; Plasma neutronics; Thin film transmission; electron microscopy of metals & alloys; Laser excited fluorescence of atomic and molecular species,	Atomic Energy
		Particle physics; Low temperature Physics: High energy accelerators; Linear accelerators.	TIFR
		Pressure transducers; Multispectral scanners,	Space
		Holographic gratings; Ultrasonic transducers,	CSIR
		High pressure hydrostatic extrusion;	CSIR
		Super conductivity; Superconducting materials systems and devices; High temperature electric furnaces; High performance laser glass; Aero elasticity and flutter; Plasma furnace.	Atomic Energy

MGIPRRND—15 ESW/79—Sec. I—D—6-3-80—2000